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The High-School Science Teacher

For the past 8 years, Ray Maul of the National Education Association's Research Division has published annual reports on the supply of new school teachers and the demand for such teachers. Because the studies have been made on a nation-wide basis, because comparable figures are now available for a continuous period of years, and because of the detail of breakdown by school level and subjects taught, Maul's figures have become the most valuable existing source of information on teacher supply and demand trends.

The eighth annual report (printed in *The Journal of Teacher Education* for March 1955) contains some discouraging figures for those concerned about the future supply of scientists in the United States. A little extrapolation of Maul's figures indicates that in the fall of 1954 some 5700 new teachers were employed to teach high-school science and mathematics courses. Some of them had to teach other courses, but their major assignments were in science and mathematics. Where did they come from, and what was their preparation?

Maul's figures indicated that only 2300 were new college graduates who had prepared for work as high-school teachers of science or mathematics. Among the other 3400 were some with excellent preparation who returned to teaching after a longer or shorter absence, due, perhaps, to a period of military service, to an interlude in graduate school or in some other type of work, or to having earlier retired from teaching to raise a family. Others were hired simply because no better qualified candidates were available. Maul's figures do not tell how many were in each of these categories, but the testimony of many school officials indicates that the really well qualified were in the minority.

More disturbing than the figures for a single year are the continuing trends. High-school enrollment dropped during the decade prior to 1952, is now beginning to increase, and will soon start a rapid expansion. The supply of new teachers of science and mathematics has been dropping sharply for the past several years, and, although it may rise in the future, short of a severe economic depression it cannot possibly rise as rapidly as will the demand.

The same month that saw the appearance of Maul's most recent report also brought publication of a report on the *Supply of Teachers of Mathematics and Science in Scotland*. The Scottish report discussed in some detail the current shortage and the larger shortage anticipated for the future. As in the United States, the changing birth rate of the past few decades is partly responsible. Again as in the United States, low salaries and the keen competition of industry and government persuade many a young man or woman who had considered science teaching to cast his lot elsewhere.

The shortage will be too great to remedy by any single or easy solution. A variety of adjustments will be necessary, and there may be major changes in the whole organization of high-school teaching, such, for example, as the widespread use of teaching films or closed-circuit television. While such solutions are being considered, one of the potentially most valuable reactions to the shortage has been the reaction of scientists. By and large, there has been a considerable gulf between research or academic scientists and teachers of high-school science. The gulf is being bridged. University departments of science, major scientific associations, including the AAAS, and a growing number of industrial scientists are recognizing that the problem concerns all scientists, for the quality of high-school teaching affects the number and quality of future scientists.—D.W.

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Statistics—Servant of All Sciences

Jerzy Neyman

The purpose of this article is to report on the first part of the Third Berkeley Symposium on Mathematical Statistics and Probability, which was held 27–30 Dec. 1954. The symposia are organized by the Statistical Laboratory, University of California, at approximately 5-year intervals; the first two were held in 1945–46 and in 1950, respectively. In organizing these symposia, the laboratory places emphasis on the *Proceedings*, which are published by the University of California Press. Although ordinary research papers are gladly accepted for publication in the *Proceedings*, preference is given to articles that tend to integrate research efforts in particular domains and that outline prospects for the future.

The *Proceedings* of the first two Berkeley symposia (*1, 2*) cover developments in the theory of statistics, in probability, and in various fields of application, from the physical sciences through biology and economics, to certain aspects of engineering. Owing to the generous support of the National Science Foundation, the Air Research and Development Command, the U.S. Air Force, the Office of Naval Research of the U.S. Navy, and the Office of Ordnance Research of the U.S. Army, the present symposium proceedings will be more comprehensive than the first two. It is hoped that the proceedings, five volumes of 200–300 pages each, will be published early in 1956.

The December meeting, which was held in conjunction with the annual meeting of the AAAS, represented the first part of the Third Berkeley Symposium. Because of the general character of the AAAS meetings, emphasis was placed on applications. Thus statistics was treated mainly as a faithful "servant" of empirical sciences. However, in the view of the Statistical Laboratory, both statistics and probability are independent mathematical disciplines, and, unless they are diligently cultivated as such, their "services" can be of only limited utility. For this reason, the second part of the third symposium emphasized theory. It was held this summer as a leisurely seminar, extending through July and August.

Before proceeding to the description of the nine sessions of the third symposium that were held last December, it may be well to explain the point of view of the Statistical Laboratory on the essence of both statistics and probability and on their role in the present development of science in general.

The development of modern science is marked by a pronounced tendency toward indeterminism. A somewhat brutal description of this tendency may be stated as follows. In relation to some phenomena, instead of trying to establish a (deterministic) functional relationship between a variable y, and some other variables $x_1, x_2, \cdots, x_n$, we try to build a (stochastic or probabilistic) model of these phenomena, predicting frequencies with which, in specified conditions, the same variable y will assume all of its possible values. For example, future research might conceivably develop methods of obtaining individual characteristics of progeny as a single-valued function of characteristics of the ancestors and of some other now unsuspected data. This would be a deterministic approach to problems of heredity. However, current genetic studies approach these problems differently and are concerned with establishing *how frequently* a progeny of a given parentage exhibits a given set of characteristics. Similarly, rather than seeking a deterministic formula that connects with some specified variables the exact time of disintegration of a given atom, we try to develop formulas that determine *the proportions* of such atoms that will disintegrate within the next minute, within the next 2 min, and so forth.

The problem of deducing the relative frequencies (probabilities) of some events from given relative frequencies of some other events is the problem of the theory of probability. This explains the remarkable recent development of this discipline and the unusually broad range of its applications. However, the same applications require the solutions of some problems also expressed in terms of probabilities (relative frequencies), but falling outside of the usual domain of the theory of probability proper. These are the problems of statistics. They may be exemplified as follows.

Suppose a stochastic model M is advanced to represent (or to explain) certain phenomena P. The question immediately arises whether the representation is satisfactory. The observations provide a certain number, frequently only a small number, of data, $x_1, x_2, \cdots, x_n$ and these data must be used to decide whether to accept or to reject the model M. In situations of this kind the possibility of erroneous decisions cannot be eliminated, and the best one can do is to seek methods of making decisions that, in a sense, minimize the risk of mistakes. The search for methods of making decisions on data subject to (as we call it) random variation is the subject of modern statistical theory. A rough-and-ready means of distinguishing between a problem of pure probability and a problem of statistics is to examine the quaesitum of the given problem. If the quaesitum is a probability (relative frequency), then we are in the domain of probability theory. If the quaesitum is a method of proceeding or of deciding that minimizes the probability of an error (or that minimizes a risk function defined in probabilistic terms, and so forth), then we deal with a statistical problem.

Because of these particular domains of study, the field of application of statistics and probability is literally limitless. Briefly, their role in scientific research consists (i) in providing tentative stochastic models of given classes of phe-

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nomena and (ii) in developing optimal methods of dealing with the observations in order either to supplement the original models with certain details such as the estimates of the various constants they involve, or to decide for or against the further retention of these models. Details of my views on this subject may be found elsewhere (*3*).

The December 1954 program of the Third Berkeley Symposium included one session each on biology, statistical mechanics, medicine and public health, probability and induction, theory of statistics, industrial research, and psychology and two whole sessions on astronomy. Thirty-two papers were presented at these nine sessions. Under these circumstances, even a substantial report on the meeting must either be reduced to an enumeration of names and titles or be restricted to selected items. I have adopted the second alternative. Every such selection is unavoidably arbitrary and subjective. The selection adopted here is motivated partly by the desire to meet the interests of the prospective reader of this article, presumably a nonmathematician, and partly to illustrate some of the points mentioned in the introduction. In addition, the selection is somewhat influenced by the availability, at the time of writing, of the manuscripts of papers submitted for publication in the proceedings.

Struggle for Existence and Evolution

Three papers given at the first session of the symposium were concerned with the struggle for existence and evolution. One, by J. Neyman, Thomas Park, and E. L. Scott, dealt specifically with competition of species; the two others, one by Everett R. Dempster and the other by James F. Crow and Motoo Kimura, dealt with population genetics.

The Neyman-Park-Scott paper summarized the results of several years' cooperative study conducted by the Hull Zoological Laboratory of the University of Chicago on the one hand and by the Statistical Laboratory of the University of California on the other. The starting point of these studies was the set of remarkable facts discovered by Park concerning the competition between two species of *Tribolium*, *T. confusum* and *T. castaneum*. If husbanded in isolation from each other in appropriate fixed conditions of temperature and humidity, these two species were observed to maintain reproducing populations extending over a number of years. The numbers of adult individuals of these populations fluctuated around certain points of apparent equilibrium; neither population showed any tendency toward extinction. Denote by ε_1 and ε_2 the points of equilibrium of the two species corresponding to some fixed conditions of temperature and humidity. When these conditions change, ε_1 and ε_2 also change. We will consider the particular conditions C in which $\varepsilon_1 > \varepsilon_2$ so that *T. confusum* appears more "virile" than *T. castaneum*.

In parallel with husbanding the two species of *Tribolium* separately, Park had a number of identical containers in which he attempted to develop, under the same conditions C, mixed populations of *T. confusum* and *T. castaneum*. A priori one might expect that the mixed populations will develop at some equilibrium level intermediate between ε_1 and ε_2, with the majority of adults belonging to the more virile species. However, in a substantial number of replicates observed in six different systems of conditions C, this kind of result was *never* observed. Instead, invariably, one of the two competing species completely died out, leaving the field to the other, which then proceeded to establish its usual point of equilibrium. The particularly interesting points of these experiments are (i) that, under the fixed conditions C, the identity of the surviving species is not always the same, and (ii) that the apparently more virile species is not always the more frequent winner. Thus, for example, the conditions C exist in which $\varepsilon_1 > \varepsilon_2$, so that *T. confusum* appears more virile than *T. castaneum*, and yet the *T. castaneum* is predominantly the winner of the competition.

Confronted with these experimental results, one is tempted to assume that they indicate either that the active forms of one species fight (literally) with those of the other (this has never been observed) or that the contacts between the two species result in some biological changes in the particular individuals. Perhaps the females alter the frequency of laying eggs. In order to describe this kind of interaction, the term *biological interaction* was introduced. However, it is not impossible that the observed phenomena might be a consequence of another kind of interaction, termed *statistical*, that does not involve any biological changes in the individuals. Actually, one of the contributions of the Statistical Laboratory is a model of statistical interaction based on the assumption that the two competing species differ (i) in the number of eggs laid by a female in a lifetime, (ii) in the duration of inactive phases of the life-cycle (egg and pupa), and (iii) in the "voracity" of active forms (larva and adult) which eat indiscriminately the eggs (and occasionally pupae) of either species. Qualitatively, the consequences of this model agree with the observations. Unfortunately, in order to obtain workable formulas, it was necessary to incorporate into the model a number of simplifying assumptions, including the hypothesis that the successive generations of *Tribolium* follow each other in a discontinuous manner, without overlaps. Whether or not the model is sufficient to represent the phenomena quantitatively will be an open question for some time. An effort to study this problem led to new experimentation and to several probabilistic studies concerned with the random walk of beetles.

Of the two papers on genetics, only one is now available, E. R. Dempster's. Its subject may be symbolized by the names of R. A. Fisher (*4*), Sewall Wright (*5*), K. Mather (*6*), Oscar Kempthorne (*7*), C. Cockerham (*8*), I. M. Lerner (*9*), and, of course, Dempster himself. It is concerned with statistical methods designed to detect the *epistatic deviations*. In order to explain the term *epistatic deviation*, we will consider a measurable characteristic X of an organism and assume for a moment that, apart from environmental variation, the value of X is determined by two pairs of genes A, a and B, b only. Each pair of these genes gives three different genotypes AA, Aa aa and BB, Bb, bb, which furnish altogether nine different combinations. Denote by X_{ij}, $i,j = 1,2,3$ the average dimension of the characteristic X corresponding to the genotype symbolized by the two subscripts i and j. Thus, for example, symbol X_{11} will correspond to the genotype $AABB$, symbol X_{23} to the genotype $Aabb$, and so forth. Now, let us use a dot in order to symbolize the averaging for a given index. Thus, for example, $X_{2.}$ will represent the average of X_{21}, X_{22} and X_{23}. Also the symbol $X_{..}$ will represent the grand average of all the nine different values of X_{ij}.

The values of $X_{1.}$, $X_{2.}$, and $X_{3.}$, or their deviations from the grand average $X_{..}$, represent the population effect (or, more precisely, the average population effect) of the genes of the first pair, Aa. The same applies to averages $X_{.1}$, $X_{.2}$, and $X_{.3}$ in relation to the second pair of genes. Now it may happen that, for each pair of values of i and j, the genotype value X_{ij} is exactly equal to the additive combination of the average genotype effects of the two pairs of genes, so that

$$X_{ij} - X_{..} = (X_{i.} - X_{..}) + (X_{.j} - X_{..})$$

However, the exact occurrence of this equality is not very likely and the differences between the two sides of this equation are labeled *epistatic deviations*. The epistatic deviations will not equal zero if the effects of genes of one of the two pairs depend on the genetic composition of the organism with respect to the other pair. For the sake of brevity, we have considered the simplest case in which the characteristic X depends only

on two pairs of genes. In reality, the situation is much more complex, and a great number of different epistatic deviations come under consideration.

Medicine and Public Health

Four papers were presented at the session on medicine and public health. Two, by William F. Taylor and A. T. Bharucha-Reid, dealt with the concept and with the methods of statistical evaluation of contagion. One paper, by Chin L. Chiang, Joseph L. Hodges, Jr., and Jacob Yerushalmy, was concerned with the evaluation of diagnostic tests. The last paper, by Jerome Cornfield, had for its subject the statistical problems arising from the *retrospective studies*, exemplified by the recently publicized studies of the effect of smoking on the incidence of cancer of the lung.

Although the fact is not mentioned in his paper, Taylor presented a detailed account of his own organizing-research activity as head of the biometry division, School of Aviation Medicine, U.S. Air Force. Actually, the problems sketched must represent only a section of this activity, that concerned with the concept of contagion—in accidents on the one hand and in disease on the other hand. The paper contains a well-designed background description of previous work, which was performed mostly in England and Scandinavia, and a comprehensive list of the problems facing the School of Aviation Medicine. One group of these problems—problems concerned with epidemics—was farmed out to a project at Columbia University under Bharucha-Reid; the other—problems concerned with accident proneness and accident contagion—was sent to a research project at the Statistical Laboratory, Berkeley.

Problems of the first category may be exemplified by the following. Various army camps are sometimes affected by epidemics, occasionally severe epidemics. The soldiers in these camps are housed in barracks, which, naturally, vary in a number of respects from one camp to the next. The problem arises, how much of a given epidemic is picked up outside the barracks and how much of it is the result of conditions within the barracks. A proper solution of this problem requires the development of a realistic model of what is called "within-family contagion." Some work on this subject had already been done at the Statistical Laboratory, notably by William R. Gaffey. However, his model is somewhat primitive, for it is based on the assumptions of indefinite infectiveness and zero incubation period. Reid's paper suggests that its author is well on his way toward very useful generalizations.

Among the many accident-proneness problems, the most interesting appears to be that of "tapering contagion." The first stochastic model of contagion was constructed about a quarter of a century ago by Pólya (*10*). For some time it was thought that the distributions this model generates are indistinguishable from those that would be observed in the absence of contagion of accidents, provided that the individuals subjected to observation vary in a particular way in their inherent proneness. Recent work (*11*) has shown that, if the observations are sufficiently detailed in respect to times of accidents, this difficulty does not arise. In fact, a test for the presence of the Pólya contagion has been successfully developed (*12*). However, closer analysis of Pólya contagion indicated that it is not likely to affect the accidents in flying. One of the basic assumptions of this theory is that, apart from a possible gain in experience, the effect of past accidents on the individual to whom these accidents occurred is independent of the time elapsed. On the other hand, intuition suggests that the effect of an accident, if any, is likely to be felt strongly in the period immediately following this accident but will probably taper off as time goes on. An initial study of tapering contagion is in progress at the Statistical Laboratory, particularly by L. M. LeCam.

In 1947 Yerushalmy (*13*) made a remarkable discovery that, if a radiologist makes several *independent* examinations of the same film representing an x-ray picture of an individual's lungs, then, ordinarily, the outcomes of such examinations are subject to variation: occasionally this outcome will be positive and occasionally negative. As one might expect, there are exceptions to this rule: if an individual is heavily affected by advanced tuberculosis, then all the repeated readings of the x-ray pictures by the same radiologist and by several different radiologists will be unanimously positive. However, with incipient tuberculosis and with individuals entirely free from tuberculosis, a radiologist's opinions about the same x-ray picture vary from one independent examination to the next, and this appears to be true for radiologists of highest repute. This fact itself should not be surprising because, after all, the radiologists are human!

Since this work of Yerushalmy, the problem of assessing medical diagnostic tests has been the subject of intermittent studies at the Statistical Laboratory (*14*, *15*).

In relation to diagnostic tests with only two possible verdicts, positive or negative, the statistical approach to the assessment leads to the consideration of the probability, say p, that a single application of the given test to a specified individual will lead to the verdict positive. At least two different values of this probability must be considered, one, say p_1, corresponding to individuals who are really ill with the disease contemplated, and the other, say p_2, corresponding to those who are free from this disease. Ideally, p_1 should be equal to unity and p_2 to zero. However, ideals are unattainable and one must be content with diagnostic tests for which p_1 is large and p_2 is small or, at least, for which p_1 is substantially greater than p_2. If these numbers are known, then it is easy to arrange that repeated application of the same test leads to an arbitrarily sharp discrimination between the sick and the well. Thus, in order to assess statistically a given diagnostic test, one must face the problem of using some available or obtainable experimental data in order to estimate p_1 and p_2. This problem is of particular interest in those frequent cases in which, as is the case with syphilis, there are considerable difficulties in establishing whether a given individual is or is not really affected by the given condition. In fact, the decision in this question is frequently based on the results of the same test that is being assessed. The idea of circumventing the apparently unavoidable vicious circle seems to be due to Hugo Muench (*16*), as follows.

The statistical approach to the problem and, in particular, the consideration of the probability p of positive response to the test, presupposes the hypothesis that, if the same test is applied several, say n, times to the same individual, with reasonable care to insure independence (with some tests this may be difficult or even impossible), then the number x of positive outcomes of the test will be a binomial variable with unknown value of the parameter p and with known exponent n. Thus, if a substantial group of persons is subjected to n independent applications of the same diagnostic test, the resulting values of the variable x may be used to estimate the distribution of p in the population. This in turn may lead to the estimates of the proportion of this population subject to the condition activating the test and to the evaluation of the effectiveness of the test.

The main difficulty with the application of this method consists in obtaining the results of repeated independent applications of the same test to a substantial number of individuals. Thus, for example, Yerushalmy's data, on which the initial three publications are based, do not satisfy the conditions indicated. The analysis was based on readings of the same x-ray pictures by five *different* physicians. The same data indicated that these physicians differed in their attitudes, and thus their readings of the

same picture cannot be really considered as *replicates* of the same experiment. Neither would it be appropriate to consider as such the readings by the same physician of four x-ray photographs of the same chest made by four widely different methods, one on the standard 14- by 17-in. Celluloid film, another on a 35-mm photofluorogram, and so forth. As a result, the afore-described papers have only methodological and illustrative significance.

The same lack of data on repeated independent applications of the same diagnostic test affects the paper presented at the symposium. One of its subjects is the analysis of the situation when a single application of the test to be assessed is followed by application, only to the individuals found positive, of a crucial test, supposed to be absolutely reliable. It is shown that, even under the simplest assumption that the population is divided into two categories, the ill and the well, without any gradation in the degree of illness, it is impossible to estimate all the parameters characterizing the situation. Another interesting subject discussed is the possibility of a sequential application of the same test to the same individuals. Namely, it appears plausible that, although a quantitative response to a test of "healthy" individuals may be very variable, with the variation overlapping that of the individuals affected by illness, the differences between responses of the same individuals to the same tests applied at two different epochs may be more stable and thus may be more adaptable for purposes of discrimination. Here, then, we arrive at the same problem discussed before, that of the distribution of the results of the same test repeatedly applied to the same individual.

In order to illustrate the distinction between "prospective" and "retrospective" studies in medicine, we will follow Cornfield and consider the much-discussed question whether or not cigarette smoking increases the chances of development of cancer of the lung.

The prospective approach would require taking under observation a substantial group of smokers and an equally substantial matching group of nonsmokers and following them for a number of years. As a result of this observation, the probabilities of contracting cancer of the lung and of surviving specified numbers of years could be estimated, and then these probabilities could serve to assess the role of smoking in the development of cancer of the lung. In particular, the data of prospective studies are sufficient for estimating correctly the *relative risk* of smokers to contract cancer of the lung compared with that of nonsmokers. This relative risk, say R_1, is measured by the quotient (proportion of smokers contracting disease)/(proportion of nonsmokers contracting the disease). If $R_1 > 1$, then smokers contract lung cancer more frequently than nonsmokers.

This brief description must be sufficient to indicate many of the inconveniences of the prospective method: its application must take a substantial amount of time and is certain to be very costly. The retrospective method is much easier. In application to the cancer-cigarette smoking problem, it consists in finding in hospitals a substantial group of cancer patients, say n_1 and in determining among them the number x_1 of those who smoke cigarettes. Then this first group is matched by another, of n_2 persons, who do not suffer from cancer. Among them the number x_2 of those who are smokers is counted. If the general incidence of cancer of the lung in the whole population studied is low, then the four numbers n_1, x_1, n_2 and x_2 are sufficient to obtain an approximate estimate of what may be called the *apparent* relative risk, say R_2, of cancer of the lung of smokers compared with nonsmokers. I italicize the word *apparent* in the definition of R_2 in order to emphasize the difference between R_2 and the formerly defined symbol R_1. The apparent risk R_2 is defined as the quotient (proportion of the now living smokers who suffer from cancer of the lung)/(proportion of the now living nonsmokers who suffer from cancer of the lung).

As is true in all statistical studies, the estimation of the apparent risk from the data of a retrospective study must be subject to a sampling error. Cornfield's problem was to deduce formulas characterizing the precision of the estimate. The application of these formulas will, then, reduce the frequency of errors in judgments about R_2 to a level that may be chosen in advance. This is all that a statistician can do regarding the data of retrospective studies. However, it is of some interest to mention the weakness of the method, about which little can be done, except by an equivalent of a long-drawn-out and costly prospective study.

The defect of retrospective studies consists in the fact that they can lead only to estimates of an apparent relative risk R_2 but not to the relative risk R_1 of contracting the disease; it is R_1 rather than R_2 that is of primary interest. If R_2 is greater than unity then it is certainly indicative that smoking may affect the incidence of cancer of the lung, so that R_1 is probably also greater than unity. However, it is essential to remember that there is no logical necessity for R_1 to be greater than unity whenever R_2 is greater than unity. Thus, although repeated studies indicate that cases of cancer of the lung are more frequent among the living smokers than among the living nonsmokers, this situation is perfectly consistent with the (somewhat implausible) hypothesis that from the point of view of cancer of the lung smoking is helpful rather than harmful.

Table 1. Probabilities of contracting lung cancer and dying from it (fictitious).

State	Smokers	Nonsmokers
S_0 (alive, no cancer)	0.90	0.80
S_1 (alive, cancer)	0.09	0.01
S_2 (dead from cancer)	0.01	0.19

In order to illustrate this point we refer to the following purely fictitious situation. In order to avoid the entanglements with computing risks of death (*3*) from various causes, we will assume that, by some magic, all these risks can be eliminated, with the exception of cancer of the lung. Consider a person who at time $t = 0$ is alive and free from cancer of the lung. At time $t = T$ this person may be in one of the following three states: S_0, alive and healthy; S_1, alive but suffering from lung cancer; and S_2, dead from lung cancer. Now we shall assume the probabilities of these three states at time T separately for smokers and for nonsmokers and will select these probabilities in a way that makes smoking appear very beneficial (Table 1).

It will be seen that, with these probabilities, smoking is indeed very beneficial. During time T only 10 percent of smokers get cancer and 90 percent of those who do get it survive up to the expiration of time T. On the other hand, among the nonsmokers, 20 percent contract cancer during the same period of time and, of those who do contract this disease, only 5 percent survive.

A prospective study would reveal all these details and would lead to the estimate of $R_1 = \frac{1}{2}$. Now let us examine the possible outcome of retrospective study. For the sake of simplicity, assume that this study is to be conducted at time T in a new community set up at time $t = 0$, which at that time was composed of 10,000 smokers and 10,000 nonsmokers, with not a single one affected by cancer of the lung. At time T the community will contain about 9900 smokers and 8100 nonsmokers. Among the smokers there will be about 900 suffering from lung cancer and among the nonsmokers there will be only 100 suffering from lung cancer. Thus, apart from sampling fluctuations, the apparent relative risk R_2 of lung cancer of smokers compared with nonsmokers will be

$$R_2 = \frac{900}{9900} \div \frac{100}{8100} = \frac{81}{11} = 7.37$$

This value of the apparent risk is comparable to those actually observed and reported by Cornfield. It will be observed that the conclusions it suggests are in

striking contradiction to those indicated by the value of $R_1 = \frac{1}{2}$, which represents the relative risk of contracting cancer of the lung.

As mentioned previously, the figures just given are purely fictitious. The sole purpose of publishing them is to call attention to the difficulties of interpreting the results of retrospective studies (*17*). In addition, it may be useful to mention that, under certain conditions, a special kind of study is possible that may be labeled "prospective in retrospect," which could give results essentially equivalent to those of prospective studies. For the possibility of prospective studies in retrospect, it is necessary to have an organization that keeps, as a matter of routine, detailed health records of a large number of individuals. If this is done for a substantial number of years, then, in order to investigate in retrospect the effect of any given condition S (such as smoking) on the incidence of some specified disease, it is sufficient to select from the accumulated records those referring to individuals who, say 10 years previously, had the condition S and to compare them with a similar control group. In this country data of this kind may perhaps be found in the records of the armed services and of the Veterans Administration. In Great Britain similar possibilities may exist at the National Health Service.

Psychology

Three papers comprised the session on psychology. Frederick Mosteller discussed stochastic models of the process of learning; Herbert Solomon considered a number of statistical problems in psychometric work; and T. W. Anderson and Herman Rubin discussed statistical inference in factor analysis. Only the first of these papers lends itself to a brief description.

Mosteller's paper may be considered as a summary of the ideas crystallized in the course of preparation of a book (*18*) written jointly with R. R. Bush. It dealt with experiments on learning by a number of organisms, including human beings (*19*), rats (*20*), dogs (*21*), and paradise fish (*22*).

In the simplest form, an experiment consists in giving an organism a signal and then letting it make a choice between certain two actions A_1 and A_2. One of these actions is "right" in the sense that, with the probability $\pi > \frac{1}{2}$, it is followed either by a "reward" or, at least, by the avoidance of a "punishment" (for example, an electric shock). The experiments indicate that, after a number of exposures to the afore-mentioned trials, the organisms studied learn to associate the signal with the subsequent reward (or punishment), not only when the connection between the two is a permanent one, so that $\pi = 1$, but also when $\frac{1}{2} < \pi < 1$.

In order to treat these situations stochastically, Mosteller describes a model as follows. It is postulated that to every nth trial there corresponds a probability p_n that the experimental animal will take the right action A_1. The probability p_{n+1} of the animal's taking the same action A_1 at the next trial is connected with p_n by a formula of the type

$$p_{n+1} = \alpha p_n + (1 - \alpha)\lambda$$

where α and λ are two parameters between zero and unity, the values of which depend upon the outcome of the nth trial but not on the number n. As simple as this model appears to be, there are very considerable difficulties both in testing it against the observations and in estimating the values of the parameters it involves. Very interesting work on these subjects, both empirical and theoretical, is in progress.

Industry

During the session on industry, three papers were presented. The first, by Albert H. Bowker, gave a broad survey of recent developments in sampling inspection, mostly developed by a large project at the department of statistics at Stanford University. The second paper, by Milton Sobel, discussed the problems of "life testing." The third, by Cuthbert Daniel, outlined various designs of industrial experimentation. All three papers are very important but are a little too technical for a brief summary in the present account.

Astronomy

H-R diagram. One of the sessions on statistical problems in astronomy, with a total of five papers, was given to the H-R diagram. For the benefit of non-astronomer readers who, like myself, might think that this diagram represents a variable quantity H plotted against another variable quantity R, it may be well to explain that the two letters refer to the names of astronomers E. Hertzsprung and H. N. Russell. Quite some time past, it was suspected that the absolute brightness of stars and their temperature are connected by a relationship that depends on the chemical composition and on the size of the stars. Some 40-odd years ago, almost simultaneously, Hertzsprung and Russell had the lucky idea of plotting the estimated absolute magnitude of a number of stars against the *spectral type*, a quantity highly correlated with temperature. The resulting diagram, the H-R diagram, has a striking appearance that reveals at a glance three principal classes of stars, the stars of the "main sequence," the "giants," and the "white dwarfs," for which the relationship between the luminosity and the temperature follows a different law.

Partly owing to the difficulties and, therefore, to the inaccuracy of measurements, the original H-R diagram had a somewhat fuzzy appearance, with the points showing a considerable scatter. However, as time went on and the methods of measurement improved, the scatter diminished, which indicated a number of refinements of the original classification of stars and led to important conclusions regarding their evolution (*23*).

The five papers presented at this session, by Bengt Stromgren, J. L. Greenstein, Gerald E. Kron, Harold Johnson, and Olin Eggen, are too technical for a more detailed summary.

Spatial distribution of galaxies. The term *galaxy* is used to denote a multimillion group of stars separated from other similar groups by colossal, relatively empty spaces. On the photographs of the sky the galaxies appear as somewhat fuzzy spots, occasionally indicating spiral organization; at times they are rather difficult to distinguish from stars.

There are two fascinating questions about galaxies. One concerns the distribution of galaxies in space. Are they distributed randomly with a sort of statistical uniformity or are they elements of still more gigantic systems? The other question is connected with the remarkable phenomenon that, judging from the position of the identifiable lines in the spectra of galaxies, practically all of them appear to recede from the Milky Way. Furthermore, the more distant a galaxy appears to be, the greater its velocity of recession. The measurements of these velocities are mostly due to the efforts of Humason and Mayall of the Mount Wilson and Palomar Observatories and the Lick Observatory, respectively. The last officially announced recession velocity amounts to about one-fifth of the velocity of light.

Although the term *velocity of recession* was used freely in the previous paragraph, I wish to emphasize that, as yet, there is no unanimity among astronomers concerning the reality of the phenomenon of recession. There is no doubt that the spectra of galaxies show shifts of spectral lines. In addition, thus far there is known only one phenomenon capable of producing shifts in the spectral lines, namely, the phenomenon of motion. A velocity of a source of light toward the observer produces shifts of spectral lines toward the violet, and a velocity away from the observer produces shifts toward the red. However, it is just possible that

similar shifts of spectral lines can be produced by some other phenomenon thus far unknown, perhaps the "aging" of light. For these reasons, it appears interesting to obtain some sort of independent evidence for or against the assumption that the galaxies recede from us (hypothesis of "expanding universe").

The three papers presented at the symposium dealt, essentially, with only the afore-mentioned two questions, or, more precisely, with the methods by which these two questions could possibly be solved. Up to the early 1930's the idea prevailed that the spatial distribution of galaxies is statistically uniform (*24*) except for occasional clusters. At present this idea is abandoned in favor of the idea of universal clustering. Thus clusters of galaxies become objects of independent studies. The first paper, by Fritz Zwicky, gave the first extensive collection of data regarding clusters. The second paper, by J. Neyman, E. L. Scott, and C. D. Shane was a summary of results obtained in a 5-year cooperation between the Lick Observatory and the Statistical Laboratory on the problem of distribution of galaxies. The empirical part of the study was based on the collection of plates taken by Shane and Wirtanen (*25*), which at the present time represents the most extensive and systematic material for statistical studies of galaxies. The theoretical part of the work included formulas characterizing the distribution of images of galaxies observable on the photographic plates both when the universe is static and when it is expanding. Roughly speaking, in the case of an expanding universe, the photographic plates would contain relatively more images of clusters with small angular dimensions than would be the case in the absence of expansion. Unfortunately, the formulas are quite complicated, and it will be some time before their numerical evaluation can throw some new light on the problem studied.

The third paper, by George C. McVittie, was closely connected with the theory developed in Neyman, Scott, and Shane's paper. If the observed shift of the spectral lines actually is caused by velocities of expansion, then one must admit that for distant galaxies these velocities are tremendous and the observable distribution of images of galaxies is likely to be affected by relativistic effects of transmission of light. Thus, McVittie's paper dealt with modifications of the original theory that appear necessary in the light of the theory of relativity.

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Wendell M. Latimer, Chemist

Wendell Mitchell Latimer was one of Gilbert N. Lewis' more important selections when he was building his chemistry department at the University of California. Latimer had an important part in shaping the department and succeeded Lewis as dean of the College of Chemistry at Berkeley. Chemistry lost one of its more versatile and prolific contributors on 6 July 1955 at the age of 62. Weakened by successive gall-bladder operations, Latimer appeared to be recovering satisfactorily when a recurrence of the difficulty weakened him further and he died in his sleep. He leaves his wife Glatha (Hatfield) Latimer, a son Robert Milton Latimer, who is a student of chemistry, a daughter Mrs. Eleanor L. Colborn and two grandchildren Diane and Robert Edgar Colborn.

Latimer was born in Garnett, Kansas, 22 April 1893, the only son of Walter and Emma Mitchell Latimer. He entered the University of Kansas, planning to become a lawyer. He found that he enjoyed mathematics and sought some subject to which he might apply it. His first contact with chemistry came during his third year at the university. The subject captured his interest and he decided to become a chemist. He was partly self-supporting as a student and was employed to make meteorological observations. He received the B.A. degree from the University of Kansas in 1915 and served as instructor there from 1915 to 1917. Latimer came to Berkeley as a graduate student because of G. N. Lewis' reputation and his study of some of Lewis' papers. In 1919 he received the Ph.D. degree from the University of California. His research, under the direction of G. E. Gibson, was concerned with low-temperature calorimetry. He was retained as a member of the staff and attained the full professorship in 1931. He served as assistant dean of the College of Letters and Science, 1923–24, as dean of the College of Chemistry 1941–49, and chairman of the department of chemistry 1945–49. He was Guggenheim Memorial Foundation fellow in Munich in 1930. He was associate editor of the *Journal of Chemical*

Physics 1933–35, associate editor of *Chemical Reviews* 1940–41, and since 1937 editor of the Prentice-Hall Chemical Series.

Latimer was active in the National Defense Research Committee from 1941 to 1945 in the fields of oxygen production, chemical warfare, and plutonium research. He was director of a Manhattan Engineering District project in the department of chemistry on the chemistry of plutonium from 1943 to 1947, and since that time he has served as associate director of the Radiation Laboratory of the University of California at Berkeley for chemistry. He also supervised considerable war work on the effect of meteorological conditions upon the behavior of toxic gases. This activity led him to England in 1943 and to Panama, Australia, and New Guinea in 1944. After World War II he served as a member of the Office of Naval Research Panel on Research Contracts on Chemistry 1949–52, of the Special Weapons Panel of the Atomic Energy Commission 1947–51, and of the Army Chemical Research Board 1946–51.

Latimer was a member of the National Academy of Sciences, serving as chairman of the chemistry section 1947–50; American Chemical Society; Electrochemical Society; Faraday Society; American Association for the Advancement of Science; American Academy of Political Science; Sigma Xi; and Alpha Chi Sigma.

Latimer's some 100 scientific contributions are largely concerned with the application of thermodynamics to chemistry. However, he worked on such diverse subjects as dielectric constants, coefficients of expansion at low temperatures, thermoelectric effect and electronic entropy, the ionization of salt vapors, radioactivity, and astrochemical problems in the formation of the earth. His long-continued and major interest involved the measurement of low-temperature calorimetric properties and the use of the third law of thermodynamics to determine the entropies and free energies of aqueous ions. This work supplied much of the material included in his outstanding book *Oxidation Potentials*, first published in 1938 and revised in 1952. He also co-authored the books *A Course in General Chemistry*, with W. C. Bray and *Reference Book of Inorganic Chemistry*, with J. H. Hildebrand.

One of Latimer's early and important contributions was his paper with W. H. Rodebush on the hydrogen bond. His was the first recognition of this bond as a general phenomenon in which a proton is held between two electronegative atoms. The properties of numerous organic and inorganic substances, including water, are largely determined by hydrogen bonding. The basic idea has found wide and rapidly increasing application. For example, in Linus Pauling's book *The Nature of the Chemical Bond*, some 50 pages are devoted to the discussion of examples of hydrogen bonding, and he states: "I believe that as the methods of structural chemistry are further applied to physiological problems it will be found that the significance of the hydrogen bond for physiology is greater than that of any other single structural feature."

Latimer spent a large amount of his time helping others, and he had a stimulating effect on his colleagues and students. For example, he was mainly responsible for initiating a seminar on nuclear chemistry which interested such men as Libby, Seaborg, Wahl, and Kennedy in that subject and helped lay the foundation for the discovery of plutonium. The first separation and identification of the new element plutonium depended on the relative oxidation potentials of the heaviest elements, and the fact that Latimer was the world's foremost expert on oxidation potentials and was available for oral consultation contributed heavily to the discovery of this extremely important element. During my own early research years, I worked in the laboratory beside Latimer, and for some years following 1922 I shared his office at his invitation. It was during this period that I learned many of the facts concerned in gas liquefaction by watching Latimer build and operate the first successful hydrogen liquefier in the United States and extend research to these temperatures. This obviously had its effect on my later low-temperature work, and these recollections, along with our 36 years of association, leave me with a deep sense of personal, as well as scientific, loss.

No department can attain and maintain a position of first rank unless it has talented students. During the last two-thirds of the G. N. Lewis period at Berkeley, and during his own administration, Latimer was the talent scout of the department. He was expert at detecting signs of originality in graduate students seeking admission or invited to seek admission. Those admitted rarely failed to obtain results that produced a happy situation for all concerned. Latimer was administrative head of his department during the inevitable period of expansion following World War II. In this period he enlarged his faculty by a group of young men who have considerably broadened the range of research activities and who are maintaining the distinguished research position of the department.

Latimer received the United States Presidential Certificate of Merit for his contributions during World War II and the Distinguished Service Award of the University of Kansas, both in 1948. He was Faculty Research Lecturer of the University of California in 1953 and received the Nichols Medal of the American Chemical Society in 1955.

At the time of his death he was looking forward to attending meetings of the International Congress of Pure and Applied Chemistry in Zurich, Switzerland, and the International Conference on the Peaceful Uses of Atomic Energy in Geneva later this year. His sound judgment, influence and research activities represent a loss that will not soon be compensated.

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My father took me sometimes to see masons, coopers, braziers, joiners, and other mechanics, employed at their work, in order to discover the bent of my inclination, and fix it if he could upon some occupation that might retain me on shore. I have since, in consequence of these visits, derived no small pleasure from seeing skillful workmen handle their tools; and it has proved of considerable benefit to have acquired thereby sufficient knowledge to be able to make little things for myself, when I have had no mechanic at hand, and to construct small machines for my experiments, while the idea I had conceived has been fresh and strongly impressed on my imagination.—BENJAMIN FRANKLIN, *Autobiography*.

News of Science

Sleep and Cerebral Oxygen Consumption

Numerous hypotheses have been elaborated in attempts to explain the puzzling phenomenon of sleep. At one time or another sleep has been attributed to arterial anoxemia, cerebral ischemia or anoxia, or to a generalized narcosis based on an unidentified humoral agent. New light has been shed on this old problem in a report by Mangold, Sokoloff, Conner, Kleinerman, Therman, and Kety in the July issue of the *Journal of Clinical Investigation*.

In a group of normal volunteers, measurements were made of cerebral blood flow and oxygen consumption, along with electroencephalographic and other physiological observations, during sleep and while the subjects were awake. During sleep there was a small but significant increase in cerebral blood flow, but there was no significant change in cerebral oxygen consumption or in arterial oxygen, carbon dioxide, or hemoglobin concentration. In coma or anesthesia, however, a significant reduction in cerebral oxygen consumption, sometimes to as low a value as 50 percent of normal, was demonstrated. The authors conclude that

"The state of sleep should be added to a growing list of conditions, like schizophrenia and performance of mental arithmetic, in which a good correlation between energy conversion and functional activity commonly found in other organ systems appears to be absent. This result is compatible with the current vogue of viewing the brain as a calculating or communicating mechanism which, in contradistinction to machines which do mechanical work, utilizes by far the greater part of its energy requirements merely in keeping its circuits alive and sensitive; the presence of a message, its functional usefulness or rationality adds only infinitesimally to the total load. Equally adequate, however, are hypotheses founded more on traditional biological concepts than on electronic analogues.

"Thus, when the brain is considered as a great number of functional units, many of which may be reciprocally related with regard to activity, then increased activity in one group of units may result in decreased activity in others. Under such conditions, different functions could result in an altered pattern of distribution of the activity without measurable changes in the net over-all oxygen consumption of the brain. Or, even more simply, is it not conceivable that the primitive functions of the brain, namely, the regulation of unconscious vegetative functions in the body, consume so much of the total cerebral oxygen requirements that they obscure the metabolic effects of the later phylogenetic functions found in conscious waking behavior, such as thought and reason?

"These studies have not elicited, nor were they designed to elicit, information bearing on the more subtle functional, biochemical, or electrical alterations in sleep. They do, however, render untenable those hypotheses which attribute this important phenomenon to an anoxemia, to cerebral ischemia, to narcosis, or to a generalized depression in cerebral metabolism."

Rubber Commission

The National Science Foundation has announced the appointment of a Special Commission on Rubber Research that will propose recommendations concerning the role of the Federal Government in basic research on synthetic rubber. The members of the commission are Arthur C. Cope, head, department of chemistry, Massachusetts Institute of Technology; Joseph C. Elgin, dean, school of engineering, Princeton University; Paul D. Foote, Gulf Research and Development Co., Pittsburgh, Pa.; Edwin R. Gilliland, professor of chemical engineering, Massachusetts Institute of Technology; Warren C. Johnson, associate dean, division of physical sciences, University of Chicago; William H. Davis, Davis, Hoxie and Faithfull, New York; Frank A. Howard, retired president, Standard Oil Development Co. of New Jersey; Farrington Daniels, chairman, department of chemistry, University of Wisconsin; David D. Henry, executive vice chancellor, New York University; Lawrence A. Kimpton, chancellor, University of Chicago; and William A. W. Krebs, Jr., associate professor of law, School of Industrial Management, Massachusetts Institute of Technology. Six members of the commission are scientists and five are nonscientists, in accordance with the provisions of the National Science Foundation Act, which also specifies that the commission shall elect its own chairman and vice chairman.

The synthetic-rubber research program, including the operation of a pilot plant and testing laboratory at Akron, was developed as an integral part of the synthetic rubber industry, which was administered by the Reconstruction Finance Corp. and by the Federal Facilities Corp. for the Government from the early days of World War II until recently.

On 1 July official responsibility for Federal support of synthetic rubber research passed to the National Science Foundation as a result of recommendations of the Rubber Producing Facilities Disposal Commission that was established by the 83rd Congress. The disposal commission also recommended that the Government's synthetic rubber plants be sold to private companies, and all but two of these were sold by 2 May.

The disposal commission recommended continuance, for at least a trial period running through June 1956, of the Government's synthetic-rubber research program conducted through universities and other institutions and the Government laboratories operated under contract by the University of Akron. The National Science Foundation is charged with the supervision and control of the research program and has been asked to evaluate the long-range role and responsibility of the Federal Government in this field.

The new special commission will also consider various alternatives regarding the Government laboratories at Akron, including the possible sale or lease to private industry, or to a university or other nonprofit institution, or retention by some agency of the Federal Government. The laboratories represent an original Federal investment of $2.2 million.

It is hoped that the special commission will complete its study of the entire problem and present its recommendations on or before 31 Dec., in order that its findings can be reflected in proposed legislation submitted to the second session of the 84th Congress.

Science and Politics

Scientists have an obligation to supply politicians with facts, thus reducing "the area of uncertainty and dispute to a minimum," according to Paul B. Sears, professor of conservation at Yale University. In a speech delivered on 18 Aug. at the first New England Watershed Conference, Sears, who is president-elect of the AAAS, said that this fact-gathering function gives science "a very definite relation to politics in the world today." He stated:

"I happen to have a high regard for

the art of politics and most of the men and women who practice it, for they are usually as good as we let them be. It is their duty to hammer out and execute policy. This difficult task ought not be made worse by obliging them to work in the dark. . . ."

Warning that "the certain road to defeat is to waste time in needless conflict among ourselves," Sears urged his fellow-conservationists "to get the cards on the table so that each of us knows the problems of the other fellow." He maintained that "it is surely unjust to brand a man a criminal for polluting a stream while forgetting that the public, always anxious for new industries, has been inviting this practice for a century or more. And because an enterprise wishes to expand, it is wrong to assume offhand that its owners do not care whether they ruin an area or not."

He pointed out that "the industrialist, unless he is an utter fool, knows the value of attractive living conditions for his employees." Sears also commented that there are "tremendous possibilities" for good will and collaboration in each community "once the facts are clear."

Thermal Cross Sections of Fissionable Isotopes

Recently declassified information was presented on the cross sections of the fissionable isotopes uranium-233, uranium-235, and plutonium-239 at the technical session, "Cross sections of fissionable elements," of the International Conference on the Peaceful Uses of Atomic Energy. Excellent agreement was obtained among participants from France, the United States, the United Kingdom, and the Soviet Union on values for these isotopes in the low-energy region. At the suggestion of the chairman, D. J. Hughes of Brookhaven National Laboratory, participants from the four countries met after the formal session to consider the thermal absorption and fission cross sections of these isotopes. It was decided to prepare a set of world average values for these cross sections, which could be used as a means for coordinating reactor calculations based on these cross sections. The average values are shown in Table 1. The quoted errors of the world average values given are based primarily on the spread in reported results and are sometimes larger than the errors of specific quoted results.

Table 1. International values for thermal cross sections of fissionable isotopes

Isotope	σ_{abs} (barns)	σ_f (barns)
Uranium-233	593 ± 8	524 ± 8
Uranium-235	698 ± 10	590 ± 15
Plutonium-239	1032 ± 15	729 ± 15

News Briefs

■ Ownership of outer space in connection with the proposed earth satellites has been brought up by John Cobb Cooper, authority on international air law. Cooper said recently in Montreal that agreement on how far the rights of all countries extend above the earth's surface should be reached before vehicles are sent 250 miles into outer space.

■ Discovery of a true radio star is described in the 13 Aug. issue of *Nature* by John D. Kraus, H. C. Ko, and D. V. Stoutenburg of Ohio State University.

This radio star, which is of stellar size, is located at the north boundary of the constellation Hydra, at a right ascension of 8 hours 19 minutes, and a declination of 7 degrees north. So far the astronomers have not been able to identify the radio star with any visible star, although there are several faint stars near the radio position.

■ The synthesis for the first time of cytisine, an extremely poisonous alkaloid, has been announced by E. E. Van Tamelen and John Baran of the University of Wisconsin chemistry department. Cytisine is so poisonous that it is of little practical value, but its synthesis will aid work on related substances that are useful to man.

Cytisine is one of the lupinanes. There exists in most lupinane molecules a unique, unsymmetrical, bridged structural system that various chemists have been attempting to reproduce for some years. Other alkaloids have been synthesized before, but never one of this type. In their synthesis, the investigators began with a simple coal-tar product, alpha-picoline; they built cytisine in 11 steps.

Cytisine is found naturally in certain leguminous plants, gorse, broom, and laburnum. Ancient peoples knew that these plants are extremely poisonous, and this quality very early aroused the curiosity of chemists, who isolated cytisine as early as 1865.

In the early 1930's two research groups, one led by H. R. Ing in England, the other by Ernst Spath in Austria, simultaneously worked out the chemical structure of cytisine, showing that it is one of the complex lupinanes. Van Tamelen and Baran began their work less than 2 years ago.

■ The American Institute of Physics, 57 E. 55 St., New York, will shortly commence publication of *Soviet Physics—JETP*, a periodical translation of research reports appearing in the Russian-language *Journal of Experimental and Theoretical Physics*. The National Science Foundation has granted funds to help finance the first year's operations. The editor will be Robert T. Beyer of the department of physics, Brown University, where the editorial office will be located.

The American Institute of Physics is the publisher of many of the American physics journals, for the institute is the cooperative agency of the American Physical Society, the Optical Society of America, the Acoustical Society of America, the American Association of Physics Teachers, and the Society of Rheology. The new journal will appear every 2 months, the first issue being scheduled for publication in October.

Beyer will be responsible for the assignment of each original article to a translator-physicist. Beyer himself reads Russian and is actively interested in the fields of acoustics, ultrasonics, and low-temperature physics. A survey that has been made indicates that enough Russian-reading physicists are available in the United States to translate all the contents of the Soviet journal.

An Advisory Board on Russian Translations has been appointed by the American Institute of Physics. The chairman is Elmer Hutchisson of Case Institute of Technology, who is also vice president of the abstracting board of the International Council of Scientific Unions, and other board members are Dwight E. Gray, chief of the Technical Information Division of the Library of Congress; Morton Hamermesh of Argonne National Laboratory; Vladimir Rojansky of Union College; and Victor F. Weisskopf of Massachusetts Institute of Technology.

Scientists in the News

CHARLES W. SHILLING, former captain in the Medical Corps of the U.S. Navy, has been appointed special assistant to John C. Bugher, director of the Atomic Energy Commission's Division of Biology and Medicine. Shilling recently retired from the Navy after 28 years of service. He holds a B.S. degree from Taylor University, Upland, Ind., and a B.A. degree from the University of Michigan; he received an M.D. degree from the University of Michigan Medical School in 1927. He attended the Harvard School of Public Health in 1932–33, and in 1954 was awarded an honorary doctor of science degree from Taylor University.

After internship in the U.S. Naval Hospital, Chelsea, Mass., in 1927–28, Shilling was assigned to submarine training duty and to various submarine bases. He conducted research and development work in safety, salvage, and escape equipment for submarines as well as experimental work in physiology and biochemistry related to air and oxygen under high pressure. He became a qualified deep-sea diver and served aboard the U.S.S. *Cam-*

den and the U.S.S. *S-4*. In 1939 he was senior medical officer in the rescue of personnel from the submarine U.S.S. *Squalus*.

In 1947 Shilling joined the staff of the Office of Naval Research, where he served for 6 years, successively as director of the medical sciences division, deputy for bio-sciences, and special assistant for bio-sciences. During his last 2 years at ONR, he was also director of the research division of the Navy's Bureau of Medicine and Surgery.

In 1953 he was transferred to the U.S. Naval Academy, where he filled concurrent assignments as senior medical officer, U.S. Naval Academy; command medical officer, Severn River Naval Command, and head of the department of hygiene. Shilling is the author or coauthor of 61 scientific articles and one book.

The International Council of Scientific Unions held its 7th general assembly at Oslo, Norway, 8–13 Aug. The United States was represented by the following delegation: LLOYD V. BERKNER, *chairman*, president, Associated Universities, Inc.; WALLACE W. ATWOOD, Office of International Relations, National Academy of Sciences–National Research Council; ROBERT B. BRODE, department of physics, University of California, Berkeley; DETLEV W. BRONK, president, National Academy of Sciences; WALTER H. BUCHER, department of geology, Columbia University; JASON J. NASSAU, director of the Warner and Swasey Observatory, Case Institute of Technology; WALTER M. RUDOLPH, assistant to the science adviser, Department of State; CHARLES E. SUNDERLIN, deputy director, National Science Foundation; and PAUL A. WEISS, Rockefeller Institute for Medical Research, New York.

HARRY J. DEUEL, JR., biochemist and dean of the graduate school at the University of Southern California, left on 19 July for an 8-month visit in Europe. With the support of a Fulbright grant, starting 1 Sept. he will be at the Dunn Nutritional Laboratory in Cambridge, England, for 7 months. He plans to visit many British universities, where he will lecture on such subjects, as vitamins A and E, nutritive value of fats, essential fatty acids, cholesterol metabolism, chemical food additives, and protection against x-rays offered by fats in the diet.

G. WESLEY DUNLAP, manager of the instrument and nuclear radiation engineering services department of the General Electric Co., Schenectady, N.Y., will serve for a year as a visiting professor at Massachusetts Institute of Technology. Dunlap will be the third engineer to hold the Edwin Sibley Webster professorship of electrical engineering, established by a $400,000 grant in memory of Webster, who, with his M.I.T. classmate, Charles Stone, founded the consulting firm of Stone and Webster, Inc.

ADOLPH HECHT will become chairman of the botany department at the State College of Washington, Pullman, on 15 Sept. His appointment follows the resignation of N. HIGINBOTHAM, who will continue as a professor in the department.

PAUL E. HOWE, authority on animal and human nutrition, retired on 1 Aug. from the U.S. Department of Agriculture. During a career of 31 years in the USDA, Howe has been a contributor to nutrition research and has served various Government agencies — including the Army, Department of Justice, and National Research Council—as a nutrition consultant.

Although he has been concerned chiefly with animal nutrition, Howe has also made many professional contributions to the study of human nutrition. As an expert on institutional and mass feeding, he has played a key role in the development, since World War I, of United States policies and programs concerned with the nutrition of our Armed Forces and of civilian populations in Europe and the Far East.

A native of Chicago, Ill., Howe attended the University of Illinois, where he was awarded the Ph.D. degree in 1910. He joined USDA in 1924, after 14 years of teaching and research at the University of Illinois, Columbia University, the Army Medical School, and the Rockefeller Institute. He served during World War I as a captain in the Army Sanitary Corps.

From 1924 to 1936 he was in charge of nutrition investigations for USDA's former Bureau of Animal Industry, and from 1936 to 1948 he served as assistant chief of the bureau and chief of the animal nutrition division. Howe has taught in the USDA Graduate School and has been nutrition adviser to the Bureau of Prisons, Department of Justice, since 1929, when he developed the present prison ration and method of nutritional accounting.

During World War II, as a colonel in the Sanitary Corps, he organized and directed the nutrition division, Office of the Surgeon General (1940–44), and later served as nutrition consultant to the Supreme Commander, Allied Forces, both in Europe (1944–45) and in Japan (1946–47), where he was concerned particularly with the nutritional adequacy of diets of the civilian populations.

From 1949 to 1950 he was chief of the Nutrition Mission for the Office of the Surgeon General in Germany and Western Europe. He was awarded the Legion of Honor, officer class, by the French Government for his work in France during the war.

Howe was a nutrition adviser to the National Defense Council in 1940 and a member or liaison member of the Committee on Food and Nutrition of the National Research Council from 1941 to 1944. He had served previously, from 1927 to 1941, as chairman of the NRC's Committee on Animal Nutrition. In 1951 he was a special consultant on institutional feeding to the State of California.

For 36 years (1912–48), Howe was an assistant editor (biological chemistry) of *Chemical Abstracts*, and he served as special editor for biochemistry on the staff of *Webster's New International Dictionary* (2nd Edition). He is coauthor of *Nutrition and Clinical Dietetics*, a basic reference work in this field. His many technical publications include articles on the chemistry of blood, muscle proteins, and animal products; on animal nutrition; nutrition accounting; and institutional and mass feeding of men.

Since 1948 Howe has been nutrition adviser to the USDA's former Bureau of Animal Industry and to the present Animal and Poultry Husbandry Research Branch of the Agricultural Research Service. Howe plans to continue his work in nutrition as a private consultant.

LEONARD H. SCHUYLER, who has been a research fellow in medicine at the Vascular Research Laboratory of the New York Hospital–Cornell University Medical School in New York, has been named assistant medical director of the American Heart Association. He will aid in administration of the research support and professional education programs.

WALDO SHUMWAY, dean of Stevens Institute of Technology, became the institute's provost on 1 Sept.

J. E. WALLACE WALLIN, founder and one-time director of numerous psychoeducational clinics and special education departments in New Jersey, Pennsylvania, Missouri, Ohio, Maryland, and Delaware, has received the 1955 Alumni

Meritorious Service award from Augustana College. He was honored for "his outstanding contributions to society" and also in recognition of the fact that, as a near-octogenarian, he published two major books within a few weeks of each other. One was the *Education of Mentally Handicapped Children*, a volume in Harper's "Education for Living Series," edited by H. H. Rammera, and the other was *The Odyssey of a Psychologist*, a personal record of "pioneering experiences in special education, clinical psychology, and mental hygiene," that was published under his own imprimatur.

The following members of the Columbia University faculty retired on 30 June: HARRY STOLL MUSTARD, professor of public health practice and director of the De Lamar Institute of Public Health; JAMES BURNS ANDERSON, professor of medicine; GEORGE FRANCIS CAHILL, who joined the Columbia faculty in 1917 as an instructor in urology; MAURICE LENZ, professor of clinical radiology; FRANK LAMONT MELENY, who began teaching surgical techniques in 1919 and who was a codiscoverer of bacitracin; and WILLIAM BELL DINSMOR, professor of archeology.

A. G. LOCHHEAD, since 1923 chief of the bacteriology division of the Canadian Department of Agriculture, Ottawa, retired last month. Before joining the department he lectured at the University of Alberta. Through his leadership, the division has become known throughout the world as a center of fundamental research in soil microbiology. Lochhead is a member of many scientific societies. In 1940 he became a fellow of the Royal Society of Canada, and last year he was president of the Canadian Society of Microbiologists.

HARRY KATZNELSON, head of the general agricultural microbiology unit, has been appointed successor to Lochhead. His interest in bacterial viruses led to the development of a widely used diagnostic procedure for detecting bacterial plant pathogens in seed. He is also known for his research on diseases of the honeybee.

A bronze bust of the late ALEXANDER FLEMING, discoverer of penicillin, which is to be erected in the city park in Gijon, Spain, was completed recently by Manuel Laviada.

A travel award fund honoring the memory of ERWIN BRAND for his many years of service to the division of biological chemistry of the American Chemical Society was established by the division through donations from its members and from certain industrial firms. Travel expenses paid from this memorial fund enabled two biochemists, Sidney Schulman of the University of Buffalo and T. R. Riggs of Tufts College of Medicine, to attend the International Congress of Biochemistry in Brussels, Belgium, 1–6 Aug. Industrial firms that contributed were A. E. Staley Manufacturing Co., Decatur, Ill.; Burroughs Wellcome and Co., Inc., Tuckahoe, N.Y.; and Merck and Co., Inc., Rahway, N.J.

Necrology

EGON BRUNSWIK, Berkeley, Calif., 52, professor of psychology at University of California, 7 July.

DAVID CHEEVER, Boston, Mass., 79, associate professor of surgery emeritus at Harvard Medical School, former president of American Surgical Association, 13 Aug.

ALAN DEVOE, Hillsdale, N.Y., 45, author and naturalist, 17 Aug.

HERBERT J. FRENCH, New York, 62, metallurgist, vice president of International Nickel Company, formerly on research staff, 17 Aug.

GEORGE F. PADDOCK, Providence, R.I., 76, professor emeritus of astronomy at Lick Observatory in Mount Hamilton, California, 16 Aug.

THOMAS A. WAINWRIGHT, Dhahran, Saudi Arabia, 50, executive and engineer for Arabian Oil Co., 12 Aug.

ROBERT W. WOOD, Baltimore, Md., 87, research physicist at Johns Hopkins, authority on spectrum research, 11 Aug.

JOSEPH C. YASKIN, Philadelphia, Pa., 64, head of neurology department at Graduate School of Medicine, University of Pennsylvania, 10 Aug.

Education

■ The University of California and the Atomic Energy Commission have entered into a research contract under which the university will construct a nuclear reactor specifically designed for medical treatment and research. The AEC will contribute $75,000 toward the accomplishment of the project and will support an extensive program of research utilizing the reactor. The commission will also make available enriched uranium as fuel for the reactor, which will be constructed at the new medical center in Los Angeles. The university will erect a building to house the reactor at an estimated cost of $400,000.

The North American Aviation Corp. will design and build the reactor, which will be of the low-power water-boiler type. It will operate at a heat power level of about 5 kilowatts, with a maximum power of 50 kilowatts, and it will provide neutron flux up to 10^9 neutrons per square centimeter, per second.

The reactor, which will provide both gamma rays and thermal neutrons, will be used for the treatment of human patients and the training of students in radiation therapy and in reactor techniques and theory relative to the field of medicine. This installation will provide the West Coast with its first source of slow and fast neutrons sufficient for experimental work with animals and for treatment of human beings. The unit also will produce short-lived isotopes for experimental biology and medicine.

The reactor core will be located inside a 5- by 5- by 8-foot stack of graphite bars, shielded by a 5-foot thickness of high-density concrete. Radiation ports will lead from the core to a patient treatment room, laboratory, and another room where research on animals can be performed. An access port will permit materials to be irradiated in a channel leading inside the core itself, where radiation will be the strongest. The underground reactor wing housing the complete installation will be about 45 feet wide, 60 feet long, and 27 feet high. Welton Becket and Associates have been named architects. Rate of fission will be controlled by boron control rods.

■ Under the Oak Ridge Traveling Lecture Program, a joint activity of Oak Ridge National Laboratory and the Oak Ridge Institute of Nuclear Studies, 109 Oak Ridge scientists will make available their services as lecturers to colleges and universities, particularly those in the southern region, during the coming academic year. The lecture series is part of the Atomic Energy Commission's program for disseminating scientific and technical information to institutions of higher education.

According to a brochure that has just been issued, the participants have supplied a total of 188 possible topics, touching virtually every field of scientific endeavor. Copies of the brochure and additional information concerning the lecture program may be obtained by writing to the Chairman, University Relations Division, Oak Ridge Institute of Nuclear Studies, Box 117, Oak Ridge, Tenn.

■ In Indonesian and Jordanian elementary schools, where pupils once learned science only by repeating passages from textbooks, lessons are now being taught with laboratory equipment assembled from odds and ends—burned-out light bulbs, ink bottles, rubber tubing, and bits of string. The man who is chiefly responsible for introducing this practical apparatus, which costs from $10 to $11 per school, is a Canadian educator, Herbert H. Grantham of Vancouver, B.C.

In 1953, Grantham completed a 2-year mission in Indonesia for the United Nations Educational, Scientific and Cultural Organization under the technical

assistance program. Then in Sept. 1954, while on a leave of absence from his post as acting vice principal of the Provincial Teachers College at Vancouver, he went on a UNESCO assignment to develop science teaching in Jordan.

Seventy-five of his "kits," with the tools and raw materials needed to make a science "laboratory" for an elementary school, are now ready for distribution to Jordanian teachers. One hundred teachers have been trained in their use in refresher courses conducted by Jordanian educators and by Grantham.

At one village near Jerusalem, pupils have started their own natural science museum by bringing in leaves, butterflies, and lizards. Outside the school, a paper weather-vane tells wind direction, and the wind's speed is measured by an anemometer consisting of four paper cups whirling on an axle. Low-cost, locally made equipment for science laboratories has also been introduced by UNESCO technical assistance missions in Thailand, Peru, and the Philippines.

Grants, Fellowships, and Awards

■ A fellowship in pediatric neurology is available at the Children's Neurology Clinic of the Cook County Hospital in Chicago, Ill. The fellowship will provide clinical training in the diagnosis and rehabilitation of children with neuromuscular handicaps. In addition, the trainee will be expected to participate in a clinical laboratory problem. The annual stipend will range from $3000 to $5000, depending upon the qualifications of the applicant. For further information, write to Dr. M. A. Perlstein, 4743 N. Drake Ave., Chicago 32, Ill.

■ Lederle Medical Faculty awards for 1956–57 have been announced by the Lederle Laboratories Division of American Cyanamid Co. The award program will provide financial aid for a limited period to young individuals who have demonstrated capacities both as teachers and investigators in the fields of anatomy, biochemistry, microbiology, pathology, pharmacology, and physiology. This Lederle program is also intended to assist departments in offering opportunities for development to promising individuals.

Candidates for these awards must hold faculty rank, such as instructor or assistant professor, and should be persons who plan to continue teaching and research within the disciplines named. All awards will be made directly to a designated medical school in the United States or Canada and will be specified for the use of the department for the support of the stated grantee and his academic activities.

Awards will be made for a term not exceeding 3 years. The only restriction in the case of each recipient is that the total amount, which will be awarded at a rate to be determined by the award committee, shall not exceed $10,000 in any one year to any one grantee.

In general, three types of awards will be considered with favor: (i) an award that will bring into the department a new person who has not previously been supported either by the departmental budget or by research grants; such an award will be expected to strengthen both the teaching and research activities of the department; (ii) an award that will continue the salary of an individual previously supported on research grants when those grants have terminated; such an award will be expected to strengthen the teaching activities and to maintain the research activities of the department; (iii) an award that will supplement the salary of an individual to enable the department to retain him to perform teaching and research functions vital to the department.

There are no formal application blanks. Nominations for Lederle Medical Faculty awards should be submitted to the committee through the office of the dean of a medical school and should be endorsed by him. Only one candidate from each school will be considered in any given year. It is suggested that the most suitable candidate be selected by a faculty committee.

Nominations for awards to be activated during the academic year 1956–57 *should be submitted by 31 Oct.* For information address: Lederle Medical Faculty Awards, Office of the Secretary, Pearl River, N.Y.

■ The American Cancer Society has announced that its program of clinical fellowships begun in 1948 will continue through the year 1 July 1956–30 June 1957. The regulations governing this fellowship program are the same as those for 1955–56, with a single important change: a brief annual report of the fellow's activities shall be submitted to the medical and scientific director of the American Cancer Society via the executive officer of the institution in which the fellow is working. In addition, a brief statement concerning the clinical activities of each fellow shall be submitted by the chief of service.

In some instances, grants may be awarded directly to institutions in support of graded intramural training programs. Such traineeship grants may be fluid in nature.

Fellowships will be made available primarily to teaching institutions approved by the Council on Medical Education and Hospitals of the American Medical Association. Application for one or more fellowships should be submitted by the executive officer of the applicant's institution to Dr. Brewster S. Miller, American Cancer Society, 521 W. 57 St., New York 19.

The deadline for filing is 15 Sept. No application forms are necessary, but letters of application should include (i) number of fellowships applied for, (ii) funds available to the institution from other sources for partial support of fellows, (iii) nature of specialty contemplated for the fellow's training, (iv) name of individual under whose supervision the fellow will be trained and to whom he will be directly responsible, (v) date the fellowship will commence, and (vi) thorough documentation concerning the training the fellow will receive at the institution, including facilities available—that is, tumor clinics, opportunities for diagnosis, treatment, clinical research, and so forth.

In the Laboratories

■ The Atomic Energy Commission has announced that projects proposed by the Detroit Edison Co. and Associates and by the Nuclear Power Group led by Commonwealth Edison Co. of Chicago give promise of significantly advancing power reactor technology and providing an acceptable basis for negotiation under the Power Demonstration Reactor Program (PDR). Accordingly, the commission has authorized negotiations with the two groups.

Detroit Edison and Associates propose construction and operation of a fast-breeder reactor plant with 100,000-kilowatt capacity to be completed in late 1959. The plant is to be located within the Detroit Edison's service area.

The Nuclear Power Group's proposal, which needs only to satisfy requirements applicable to AEC licenses in order that the project may proceed, is for a boiling-water reactor plant of 180,000-kilowatt capacity to be completed in 1960. The planned location is at the junction of the Kankakee and Des Plaines rivers about 44 miles southwest of Chicago. The group's license application is under consideration by the AEC.

The AEC also announced that, as submitted, the proposals of the Consumers Public Power District of Columbus, Neb., and the Yankee Atomic Electric Co. were not acceptable bases for negotiation. However, the commission has authorized discussions with both to determine whether their proposals can be changed so that negotiations can be undertaken.

The Consumers Public Power District proposes a sodium graphite reactor plant of 75,000-kilowatt capacity to be completed in 1958. The location is not yet determined. The Consumers District is

described in its proposal as "a public corporation and subdivision of the State of Nebraska" that provides electricity to 355 of the approximately 500 communities in the state. There are no private power companies in Nebraska.

The Yankee Atomic Electric Power Co. is proposing a light water-moderated and -cooled reactor plant of 100,000-kilowatt capacity to be completed in 1958. The plant probably would be located in Massachusetts on the banks of the Deerfield River in the township of Rowe, three-quarters of a mile from the Vermont border.

The commission on 7 Apr. 1955 announced that the four proposals had been received under the Power Demonstration Reactor Program. The AEC staff since has been studying and evaluating the proposals. The objective of the PDR program is to encourage wider participation in the development of nuclear power technology and to advance the time when nuclear power will become economically competitive.

In addition to the four proposals that have been received under the PDR program, the commission has under consideration an application by the Consolidated Edison Co. of New York for a license to construct and operate a pressurized water thorium-uranium converter reactor plant of 140,000-kilowatt capacity, and a proposal by the Rural Cooperative Power Association of Elk River, Minn., for a reactor plant of 22,000-kilowatt capacity. The Elk River proposal is the first received by the AEC from a rural electric cooperative.

The Consolidated Edison plant, to be built on the banks of the Hudson River at Indian Point, Buchanan, N.Y., about 24 miles north of New York, is planned for completion in 1960. The Elk River plant, to be located adjacent to the Mississippi River about 35 miles from Minneapolis, is planned for completion about 3½ years after start of construction.

■ A radioastronomy observatory was recently opened at Rao, Sweden, by Prince Bertil. Belonging to Chalmers Technological Institute of Gothenburg, the observatory has five radiotelescopes, a magnetic observatory, apparatus for measuring long-distance television signals, and other equipment.

■ Berkeley Chemical Corp., Berkeley Heights, N.J., manufacturing affiliate of Millmaster Chemical Corp., New York, is completing a new research and control laboratory. The single-story structure will contain more than 5500 square feet of usable space, of which more than half will be devoted to research and control laboratory facilities. Space has also been provided for a reference library to replace the smaller one now in use.

■ The Atomic Energy Commission has asked industrial firms interested in designing and fabricating a small nuclear reactor for testing reactor cores to submit proposals for construction. The reactor, to be built at the National Reactor Testing Station in Idaho, will be a high-pressure, water-moderated and water-cooled type. Tests of reactor cores will be conducted in the reactor under severe operating conditions as part of the commission's program for determining safe operating limits and developing reactor designs that incorporate maximum safety characteristics.

It is estimated that the cost of such a reactor will be between $250,000 and $500,000. Firms indicating interest in the project to the AEC's Reactor Development Division will be given an opportunity to submit proposals late in September 1955. Delivery of the completed reactor is scheduled for mid-1956.

■ A new bulletin containing a summary of the General Electric Co.'s guided missile programs during the past decade is now available from the company's special defense projects department. Designated R55AO519, the illustrated two-page bulletin outlines the objectives of each program, and presents a short review of important accomplishments. It may be obtained by writing to the company at 2900 Campbell Ave., Schenectady 6, N.Y.

■ Union Carbide Nuclear Co., a division of Union Carbide and Carbon Corp., has been formed to integrate the corporation's diverse activities in atomic energy. An objective of the new company will be to carry on large-scale research and development activities leading to increasing participation by the corporation in the industrial applications of atomic energy.

Kenneth Rush, a vice president of Union Carbide, has been appointed president of the new company and Lyman A. Bliss, Clark E. Center, and Oscar F. Holmgren have been named vice presidents. All of the new officers have been active in the corporation's atomic energy activities for many years.

Union Carbide has been active in the United States atomic energy program since its inception. The corporation was responsible for the design, engineering, and operation of the K-25 plant at Oak Ridge, Tenn., the first gaseous diffusion unit for the separation of uranium-235 from natural uranium. This plant has been in continuous operation, under Union Carbide management, ever since production started early in 1945. Union Carbide engineers have also been concerned with the process development and engineering design for all the gaseous diffusion plants and additions that have been built since 1946, including the installation at Paducah, Ky., which the corporation also operates. Oak Ridge National Laboratory is another atomic energy installation that Union Carbide manages for the Atomic Energy Commission.

Most of the operating divisions of Union Carbide have been active in various phases of the Government's atomic energy program: the Carbide and Carbon Chemicals Co. is the division that has operated the facilities at Oak Ridge and Paducah for the AEC; the National Carbon Co. helped develop a high-purity graphite required in the construction of atomic reactors; metallurgists of the Electro Metallurgical Co. helped develop special stainless steels and other metals for use where atomic energy equipment must withstand severe operating conditions; the Bakelite Co. made important contributions in resin-processing techniques; and the Linde Air Products Co.'s research on uranium compounds and its experience in handling large volumes of gases under pressure have proved of value in atomic energy operations.

The corporation also conducted extensive surveys for the Manhattan Project to locate uranium-bearing ores. United States Vanadium Co. was one of the country's earliest producers of uranium concentrates for the Government's atomic energy plants. It has a number of uranium mines under contract in the Colorado Plateau area as well as uranium processing mills at Rifle and Uravan, Colo. These activities will be assumed by Union Carbide Nuclear Co.

■ A building designed to keep pace with the growing research tasks required in aircraft and guided missile work is being erected at an estimated cost of $3,000,000 by the Goodyear Aircraft Corp., Akron, Ohio. The new laboratories will be the seventh in a series of buildings that Goodyear Aircraft now occupies on a 100-acre site at Akron Municipal Airport.

At present, the corporation's chief products include various types of airships, guided missiles, and components for military aircraft—including wheels and brakes, analog computers, radar and electronic devices, and plastic and fiberglass products.

New Journals

The Central African Journal of Medicine, vol. 1, No. 2, Mar. 1955. P.O. Box 2073, Salisbury, Southern Rhodesia. Bimonthly. £2 2s. per year; 7s. 6d. per issue.

Forest Science, vol. 1, No. 2, June 1955. Stephen H. Spurr, Ed. Society of American Foresters, Mills Bldg., Washington 6, D.C. Quarterly $6 per year; $2 per issue.

Journal of the Institution of Telecommunication Engineers, vol. 1, No. 1, Mar. 1955. The Institution, P.B. 481, New Delhi, India. Quarterly. R. 15 per year; R. 5 per issue.

The Kurume Medical Journal, vol. 1, No. 3, 1954. Kurume University School of Medicine, 67 Asahi-machi, Kurume-shi, Japan. Irregular.

Literatur–Schnelldienst, vol. 1, No. 1, Mar. 1955. Deutsches Kunststoff-Institut, Darmstadt, Germany.

Medical Abstracts, vol. 1, No. 1, Aug. 1955. James D. Barnes, Ed. 825 Western Savings Fund Bldg., Philadelphia 7, Pa. Monthly. $12 per year (introductory price $10).

Plant Food Review, vol. 1, No. 1, summer 1955. Combining *Plant Food Journal* and *National Fertilizer Review.* Delbert L. Rucker, Ed. National Plant Food Institute, 1700 K St., N.W., Washington 6. Quarterly.

Public Health, Social Medicine and Hygiene, Section XVII of *Excerpta Medica,* vol. 1, No. 6, June 1955. W. J. Bais, Ed. 111 Kalverstraat, Amsterdam C., Netherlands (order from Excerpta Medica Service Corp., 280 Madison Ave., New York 16). Monthly. $16 per year.

Revista Venezolana de Síntesis, vol. 1, No. 1, July–Sept. 1954. Sociedad Venezolana de Síntesis, Apartado 2.205, Caracas, Venezuela. Quarterly. $6 per year.

Miscellaneous

■ The Smithsonian Institution's division of medicine and public health has announced the opening of a new exhibit that pictorially traces the development of the drugstore. Sponsored by the American Institute of the History of Pharmacy, the exhibit features 12 hand-colored pictures commencing with an Islamic pharmacy of the 13th century and concluding with a modern American pharmacy. The original pictures, from which these reproductions were made, are all contemporary to the times portrayed.

The first privately owned, government-supervised shops that dealt primarily in drugs existed in Baghdad about the middle of the 8th century A.D. Pharmacies sprang up in Europe following the Islamic pattern, particularly after the 12th century. The pictures show that the pharmacies, like other medieval shops, were open to the street; a large shutter that closed off the shop at night served as a counter during the day.

The Smithsonian exhibit shows how the pharmacy became larger and more sheltered from the street by the 16th century; equipment became more elaborate and drug containers became more uniform in size and shape. The earliest interior view of a United States drugstore shows plain glassware and fixtures, as compared with its European counterpart. Those who cooperated in the preparation of the exhibit are George Urdang, pharmaceutical historian and director of the American Institute of the History of Pharmacy, Glenn Sonnedecker, secretary of the pharmaceutical historical society, and George Griffenhagen, associate curator of the Smithsonian's division of medicine and public health. The exhibit is located in the Arts and Industries Building, Washington, D.C.

■ A competitive examination for appointment of medical officers to the Regular Corps of the U.S. Public Health Service will be held in various places throughout the country on 15, 16, and 17 Nov. Appointments provide opportunities for career service in clinical medicine, research, and public health. They will be made in the ranks of assistant and senior assistant, equivalent to the Navy ranks of lieutenant (j.g.) and lieutenant, respectively.

Entrance pay for an assistant surgeon with dependents is $6017 per annum; for a senior assistant surgeon with dependents, $6918. Provisions are made for promotions at regular intervals. Benefits include periodic pay increases, 30 days of annual leave, sick leave, medical care, disability retirement pay, retirement pay that is three-fourths of annual basic pay at time of retirement, and other privileges. Active duty as a Public Health Service officer fulfills the obligation of Selective Service.

Requirements for both ranks are U.S. citizenship and graduation from a recognized school of medicine. For the rank of assistant surgeon, at least 7 years of collegiate and professional training and appropriate experience are needed; and, for senior assistant surgeon a minimum of 10 years of training is required.

Application forms may be obtained by writing to the Chief, Division of Personnel, U. S. Public Health Service, Department of Health, Education, and Welfare, Washington 25, D.C. Completed application forms *must be submitted by 15 Oct.*

■ The common names of Australian insects, linked with their scientific names, are listed in Bulletin 275 of the Commonwealth Scientific and Industrial Research Organization, 314 Albert St., East Melbourne, Australia. The list, which was issued on 27 July, includes those insects and related pests that are of major economic importance, together with others selected because of their abundance or striking appearance.

This is the first official list of its kind prepared in Australia. It has been compiled by the C.S.I.R.O. Division of Entomology in cooperation with a committee appointed by the Brisbane (1951) meeting of the Australian and New Zealand Association for the Advancement of Science.

■ The National Registry of Rare Chemicals is conducted as a free public service by Armour Research Foundation of Illinois Institute of Technology, 55 W. 33 St., Chicago 16, Ill. Each year the registry receives approximately 2900 letters asking for information about thousands of rare chemical compounds. In addition, 10 to 15 telephone inquiries and numerous telegrams and cablegrams from all over the world are handled daily. Since it began operation in 1942, the registry has located chemicals for more than 20,000 persons.

Although it is not a storehouse of chemicals, the registry has cataloged more than 30,000 rare chemicals so that it may serve as a clearinghouse for scientists and industrialists who are seeking specific compounds that they cannot locate at regular supply houses. About 60 percent of all requests are answered from this card file. The remainder are filled from leads offered by scientists from Armour Research Foundation, universities, and other organizations, and—for particularly hard-to-find chemicals—through lists published in scientific journals. Such a list follows: 3-(octadecyloxy)-1,2-propanediol (batyl alcohol); 1,3,5-trivinyl benzene; technetium chloride; trinitrosophloroglucinol; 2-(*n*-butyl)pyridine; 1-octadecylpyridinium chloride; 2-methylglutamic acid; cholesterase; 2,4-dimethyl-1-hexene; 2,4-dimethyl-2-hexene; 3,4-dimethyl-1-hexene; 3,4-dimethyl-2-hexene; 2,3,4-trimethyl-2-pentene; 3,4,4-trimethyl-1-pentene; 3,3-dichloropropene; 4,5-dimethyl-*o*-phenylenediamine; 2,4-diamino-5-phenylthiazole hydrobromide; 9-amino-nonanoic acid; alpha-amyrin (alpha-amyrenol); and eriochrome cyanine.

■ In February 1956 the first issue of *Survey of Ophthalmology* will appear. It will be a bimonthly that will publish one 600-page volume a year; cost is $9. The editor will be Frank W. Newell, chief of the section of ophthalmology and associate professor of ophthalmology at the University of Chicago. He will have the active assistance of a board of about 40 ophthalmologists. A section on refraction is expected to make the *Survey* of value to optometrists.

The new journal is expected to fill a need for a publication that will select the best material from current periodical literature in ophthalmology to keep the reader up to date with progress in the field. Williams & Wilkins Co. of Baltimore, Md., will be the publishers.

Reports and Letters

Improved Method for Isolation of Adenosine Di- and Triphosphates

The technique used by Albaum (*1*) for isolation of adenosine polyphosphates from higher plants has been applied in the present studies to conidia of *Neurospora sitophila* (Mont.) Shear and Dodge. In order to extract acid-soluble phosphates quantitatively from conidia, however, it was necessary to repeat the extraction five or six times with three volumes of 5-percent trichloroacetic acid (TCA). This resulted in a large volume of liquid and very dilute solutions of phosphates. Under these conditions, 50 percent or more of the orthophosphate and adenosine diphosphate present in the original TCA extracts was lost in the barium isolation procedure. No efficient means have been found for complete breakage of the conidia; therefore, the volume of TCA could not be diminished by homogenation, which is possible when many other source materials are used.

A search was made, therefore, for a cation that would precipitate phosphates more nearly completely than barium in dilute solutions and that would still lend itself to convenient isolation and purification of adenosine triphosphate (ATP) and adenosine diphosphate (ADP) by adsorption on anionic exchange resin by the method of Cohn and Carter (*2*). Of the several cations tested, Zn^{++} was found to be most suitable. With zinc, the step involving dissolution of the original precipitate in HCl could be eliminated because the zinc phosphates are soluble in 1*N* NH_4OH, and zinc, in this solution, passes readily through the resin column, whereas orthophosphate, ATP and ADP ions are adsorbed.

For the purpose of comparing zinc and barium as precipitating agents, isolation of phosphates from one-half of TCA extracts, usually about 200 ml, was done with barium as described by Albaum (*1*), and from the other half with zinc as follows. Five milliliters of 25-percent zinc acetate solution were added to the extract. The solution was cooled to 0°C and the precipitate was collected by centrifugation. The precipitate was washed once with 15 ml of cold distilled water to remove excess TCA and then resedimented. It was dissolved in 15 ml of 1*N* NH_4OH and passed several times through a 2- to 3-cm column of Dowex No. 1 anionic exchange resin in a 100-ml burette. This was followed by two 15-ml portions of 1*N* NH_4OH to wash out the zinc. NH_4OH was removed by several 15-ml portions of distilled water. Adenosine monophosphate (AMP), ADP, and ATP were eluted differentially according to the method of Cohn and Carter (*2*) and measured spectrophotometrically at 260 mμ using adenylic acid as the standard. Most of the inorganic orthophosphate was eluted along with ADP and was measured by the colorimetric method of Lowry and Lopez (*3*), with which inorganic phosphate can be determined in the presence of labile phosphate esters.

Data are given in Table 1 from two experiments in which the yields of orthophosphate, AMP, ADP, and ATP were compared when the two procedures were used. The zinc precipitation method yielded two to nine times as much of the various phosphate fractions in the final analyses as did the barium method. Precipitation of the phosphates with zinc revealed that ADP and ATP were present in conidia in essentially equal quantities, whereas precipitation with barium would lead one to the conclusion that ADP was present in much smaller quantities than ATP. The ratio of ADP to ATP in conidia was thus considerably higher than that found in other tissues where barium precipitation was used (*1*, *4*). It is possible, since prolonged extraction with TCA was necessary, that some ATP was hydrolyzed to ADP. However, the yield of ATP was also always greater with zinc than it was with barium; hydrolysis of zinc-ATP would not account for the observed differences in ADP.

Table 1. Comparative yields of inorganic phosphate, AMP, ADP, and ATP from conidia of *Neurospora sitophila* with barium and zinc as precipitating agents. In experiment No. 1, 4.78 g (dry weight) of spores were extracted; in experiment No. 2, 9.56 g (dry weight) of spores were extracted.

Compound	Expt. 1		Expt. 2	
	Barium (μ*M*)	Zinc (μ*M*)	Barium (μ*M*)	Zinc (μ*M*)
Inorganic phosphate*	20.1	108.6	169.5	407.6
AMP	Trace	Trace	Trace	Trace
ADP	0.5	3.0	1.9	17.5
ATP	2.6	3.9	6.8	15.9

* Calculated as phosphoric acid.

The identities of ADP and ATP were confirmed by paper chromatograms developed according to the method of Cohn and Carter (*2*). Both compounds exhibited the same chromatographic properties as yeast ATP and ADP.

It would appear that use of zinc in place of barium might give a better quantitative value for ATP and ADP in tissues and cells other than fungus spores, especially when the quantity of cells is small and when large volumes of TCA must be used for quantitative extraction of the phosphates. A complete report on the application of the modified method as described here to studies on phosphorus metabolism in germinating fungus spores will be submitted for publication elsewhere.

ROBERT G. OWENS
Boyce Thompson Institute for Plant Research, Yonkers, New York

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9 May 1955

Radiocarbon Concentration in Modern Wood

Redeterminations of the absolute C^{14} concentration in wood carbon and of its variations since the industrial revolution became widespread in the late 19th century were carried out (*1*) by means of proportional counting of acetylene as described previously (*2*). No direct determination of the counting efficiency was made, but the counting rates were compared with those from material containing a mass-spectrometrically determined amount of artificial C^{14}, obtained from the National Bureau of Standards through the courtesy of H. H. Seliger.

Indications of a decrease in the specific C^{14} activity of wood at time of growth during the past 50 yr had been found previously (*3*). The decrease amounted to about 3.4 percent in two trees from the east coast of the United States. A third tree, from Alaska, investigated at that time, showed a smaller effect. The decrease can be attributed to the introduction of a certain amount of C^{14}-free CO_2 into the atmosphere by artificial coal and oil combustion and to the rate of isotopic exchange between atmospheric

Table 1. Relative carbon-13 and carbon-14 concentration (9).

Sample	Lab. No.	Years of growth, annual rings	δC^{13} ± 0.01 (%)	δC^{14} corrected for age (%)	$\left[\frac{1+\delta C^{14}}{1+2\delta C^{13}}-1\right]\times 10^3$, corrected for age
Spruce, Alaska, from Moses Point area	W-213	1875–1880	−1.14	−2.15	+0.12 ± 0.2
	W-212	1945–1950	−1.89	−5.48	−1.77 ± 0.3
White pine, Harvard Forest near Petersham, Mass.	W-206	1840–1850	−0.41	−0.93	−0.12 ± 0.2
	W-208	1936–1946	−0.08	−3.55	−3.40 ± 0.3
	W-207	1946–1953	+0.07	−2.76	−2.89 ± 0.3
Incense cedar, Yosemite Park, Calif., from 4000 ft elevation	W-214	1895–1900	−0.21	−0.32	+0.10 ± 0.3
	W-216	1940–1944	−0.50	−2.93	−1.85 ± 0.3
	W-215	1950–1953	−0.51	−2.07	−1.05 ± 0.3
Cedrela, Peruvian Amazon region, altitude 1000 ft	W-218	1890–1896	−0.30	−0.69	−0.10 ± 0.3
	W-219	1943–1946	−0.51	−1.07	−0.05 ± 0.4
	W-217	1948–1953	−0.32	−1.70	−1.05 ± 0.4
Venus mercenaria, Nantucket Sound, collected alive in 45 ft of water	W-209 (flesh)		+0.11	−6.57	−6.79 ± 0.5
	W-210 (shells)		−1.33	−2.95	−5.45 ± 0.5
Sargassum from sea surface 36° 24′N, 69° 37′W	W-211 (weed)		+0.85	−2.32	−3.95 ± 0.5

CO_2 and the bicarbonate dissolved in the oceans.

In order to obtain more quantitative data concerning the effect, mass-spectrometric C^{13} determinations were made and used to correct for isotope fractionation in nature and in the laboratory. For this purpose a few cubic centimeters of C_2H_2 of each sample were converted to CO_2 by recycling over hot CuO and sent to Urey's laboratory at the University of Chicago, where Harmon Craig kindly undertook the mass-spectrometer measurements.

Eleven samples of wood from four different trees, each sample consisting of a small range of annual rings, were investigated; for comparison, three samples of marine carbon were also measured. Two independent sets of counting equipment were used. By repeated counting of the samples for 48 hr in alternating sequence, it was possible to correct for gradual changes in the counting sensitivity of the counters. The total counting time for these determinations amounted to 4 mo, and the number of counts observed ranged from 10^5 to 10^6 for each sample.

Table 1 lists the observed C^{13} and C^{14} concentrations for the individual samples relative to respective standard concentrations. The C^{13} standard is arbitrarily chosen as 2.5 percent below the Chicago C^{13} standard (4), approximately the average C^{13} value of wood. In other words, in defining

$$\delta C^{13} = \left[\frac{C^{13}/C^{12}_{\text{sample}}}{C^{13}/C^{12}_{\text{standard}}} - 1\right] \times 1000,$$

the ratio of the standard is taken as equal to 0.975 times the ratio of Craig's standard and approximately equal to 0.01096. Column four of Table 1 lists, in percentages, the observed deviations in the C^{13} concentration of the combusted C_2H_2 samples from this standard.

Correspondingly, δC^{14} is the measured C^{14}/C^{12} enrichment with respect to a C^{14} standard. The C^{14}/C^{12} ratio of the standard chosen here is the average of four values of

$$R/1 + 2\delta C^{13},$$

where R is the measured C^{14}/C^{12} ratio in pre-1900 wood, corrected for age. The four values are those of samples W-206, W-213, W-214 and W-218. The absolute value of this ratio can be calculated from the C^{14}/total C ratio given in Table 2. This gives

$$C^{14}/C^{12}_{\text{standard}} = 1.252 \times 10^{-12}$$

Column five lists, in percentages, the observed deviation in the C^{14} concentration, corrected for age, from the C^{14} standard as defined in the previous paragraph. Deviations of the C^{14} concentrations normalized to standard C^{13} content are listed in column six, again using the fact that isotopic fractionation, either in nature or in the laboratory, affects C^{14} twice as much as it does C^{13}.

The four samples of 19th century wood gave results (after correction for age and C^{13} variation) that deviated by not more than 0.12 percent from their mean. In particular, the lower C^{14} concentration observed in the Alaskan spruce sample is paralleled by a correspondingly low C^{13} content, so that after taking into account the depletion of the heavier carbon isotopes, the same activity is derived as for the other three determinations.

Results from wood grown more recently, however, show marked variations, always in the direction of a lower C^{14} content. The tree from the east coast of the United States shows the largest effect, and the results are in good agreement with those previously reported for wood from that area (2). The smaller effects noted in the other three trees indicate relatively large local variations of CO_2 in the atmosphere derived from industrial coal combustion, and that the worldwide contamination of the earth's atmosphere with artificial CO_2 probably amounts to less than 1 percent. Hence the rate by which this CO_2 exchanges and is absorbed by the oceans must be greater than previously assumed.

At present it is not possible to make conclusive interpretations concerning the reasons for the differences (in excess of experimental uncertainties) between individual samples grown at the same time.

Carbon of marine origin is known to show a lower C^{14} content than expected when one assumes complete equilibration with the atmosphere (3, 4). No satisfactory explanation can yet be given for this fact.

In order to obtain the absolute value of the C^{14} concentrations, two samples of known C^{14} content were counted for comparison. A solution of Na_2CO_3 containing $(7.29 \pm 0.15) \times 10^{-13}$ g of C^{14} per

Table 2. Absolute carbon-14 concentrations. The results indicate counting efficiencies of approximately 70 percent for counter I and 90 percent for counter II, assuming a C^{14} half life of 5568 yr.

Measurement	Counts/min		C^{14} total C (atoms)	
	Counter I	Counter II	From NBS determination	From counting rate
C^{14} standard: corrected average of 4 wood samples	11.969 ± 0.03	15.759 ± 0.10		$(1.238 \pm 0.03) \times 10^{-12}$
Background from "dead" carbon	2.061 ± 0.02	2.267 ± 0.05		
Spiked carbonate				
Sample 1	22.230 ± 0.10	29.379 ± 0.15	$(2.472 \pm 0.05) \times 10^{-12}$	
Sample 2	30.857 ± 0.15	41.253 ± 0.25	$(3.577 \pm 0.07) \times 10^{-12}$	
Background from "blank" carbonate	2.407 ± 0.03	2.754 ± 0.05		

milliliter was obtained from the National Bureau of Standards. The solution was prepared from a carbonate with a C^{14} ratio determined mass-spectrometrically at four different laboratories with results agreeing within 3 percent. Ten milliliters and 15 ml of this solution were added to 22.335 g and 23.148 g of Na_2CO_3, respectively, for conversion to C_2H_2. A third sample, serving as a blank, was prepared from the same carbonate without the addition of a spike. The results are listed in Table 2.

Assuming 5568 yr for the C^{14} half life (*5*), one obtains from the C^{14} ratio of $(1.238 \pm 0.03) \times 10^{-12}$ for standard wood carbon, a specific activity of 14.7 ± 0.4 disintegrations/min, which is in good agreement with the value of 15.3 ± 0.5 as determined by Anderson and Libby (*6*). The lower values reported by Hayes *et al.* (*7*) and by Fergusson (*8*) of 12.9 ± 0.2 and 12.5 ± 0.2 disintegrations/min, respectively, can be brought into agreement with the reported measurement only by assuming a correspondingly longer half life.

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1. Publication authorized by the director, U.S. Geological Survey. The assistance of Meyer Rubin in carrying out the measurements is greatly appreciated. Thanks are also due to Harmon Craig, not only for providing the necessary C^{13} analyses, but also for valuable discussions concerning the geochemistry of carbon isotopes. Corrinne Alexander carried out the technical procedure of sample preparation.
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7 June 1955

Sharks in Fresh Water

In a recent number of *Science* [**121**, 759 (27 May 1955)] is a note on the occurrence of sharks and sawfish in Lake Sentani, Dutch New Guinea. In it I read "How these salt-water fish became acclimated to fresh water in a lake 500 ft above set level is unknown."

There is no mystery about this at all. That certain species of sharks and rays, including sawfishes, enter fresh water freely and travel long distances into lakes and rivers has been known for a long time. It is now 75 years since I first read of the Ganges shark (*Carcharias gangeticus*) and its attacks on people bathing in the Hugli and Ganges rivers. Long ago A. B. Meyer, a celebrated German naturalist, recorded [*Nature* **13**, 167 (1875)] that sawfish (*Pristis microdon*) up to 20 ft in length were abundant in Laguna de Bay, Luzon. In 1870 Günther recorded this same sawfish in the Amazon and its tributaries, in the Zambezi below the great falls, and in the great rivers of Borneo and Sumatra.

For the past 35 years I have been familiar with the presence of sharks and sawfish in the rivers and lakes of the tropics. In the Philippines, the Ganges shark and the sawfish mentioned previously occur in all rivers of any size and in all fresh-water lakes where there is a good-sized outlet, unimpeded by a dam or waterfall, leading to the sea. They pass through rapids to reach the upper Agusan at least 150 mi from the sea by the winding river. I found the Papuans familiar with sawfish along the Sepik River, New Guinea, more than 300 mi from the sea; these fish undoubtedly go very far beyond that point. Far from being astonished at the presence of sharks and sawfish in Lake Sentani, I would be surprised if they did not occur there. There is no obstacle to the free passage of sharks and sawfish to and from Lake Sentani and the sea, especially in the rainy season. At that time several drainage systems become one vast sheet of water.

One must remember certain facts concerning fishes found in fresh water in the rainy tropics. First, an astonishing variety of marine fishes migrate up rivers and into lakes, many of them going to the remote interior as long as they are not stopped by waterfalls. Eels, mullet, and gobies may ascend in this way to elevations of 5000 ft. Second, in time of high water many rapids unsurmountable to migrating fishes during ordinary water stages become readily passable and are no longer a serious obstacle to them, no matter what Europeans or North Americans may think about it. Some kinds of these fishes remain but a short time, but most kinds remain until they are adult or nearly so and must return to the sea to breed.

The sharks and sawfishes mentioned do not breed in fresh water but, like many other marine fishes, find lacustrine life very attractive. The ecological conditions are very favorable to their existence and there is a great abundance of easily taken food, an altogether attractive situation. Unless cut off by huge permanent fish corrals, as at the outlet of Laguna Bombon, Luzon, sharks return to the sea to breed.

I have found that forest people, such as the Mandayas and Monobos in Mindanao, believe that the sharks they see in their rivers are females and that the sawfish are the males of the same fish. However this singular belief does not seem to be held by any people who are real fisherfolk, depending on fish for their main food supply.

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13 June 1955

Physiology of a Primary Chemoreceptor Unit

Progress in the physiology of chemoreception has been hampered by the fact that in most reported experiments the criteria of sensory excitation have been limited to behavioral responses of the animals studied. In some work on vertebrates (*1*), the responses of chemoreceptors have been approached somewhat more directly by recording afferent discharges in sensory nerve fibers that supply the receptor cells. However, these studies still leave in some doubt the nature of the response of the primary receptor surface to specific chemical stimuli.

Chemoreceptor cells of insects have special advantages for experimental work in this area of sensory physiology. These advantages include accessibility of the receptors, absence of a mucus coating over the receptor surface, the fact that the axon of the primary receptor serves as afferent fiber, and the unusually prominent development and sensitivity of the chemical senses of insects. Recent histological studies on single chemosensory hairs of insects have given new encouragement to the hitherto unsuccessful attempts to record electric activity associated with functions of the primary chemoreceptor cells of insects. Gabrowski and Dethier (*2*) found that the distal processes of two neurons extend to the tip of each tarsal chemosensory hair of the blowfly (*Phormia*), and similar observations have been made on the labellar chemosensory hairs of flies (*3*). Attempts to record electric changes in the region of the neurons at the base of the labellar sensory hairs met with some success (*4*), but the results were erratic owing to local shunting of potentials from the small fibers and unpredictability of electrode placement. The present method of recording potential changes between the small localized sensory surface on the tip of the chemosensory hair and the body of the animal has proved to be convenient and reproducible, and may have applications to other organisms and other sense organs.

A 15-mm length of 1-mm (outside

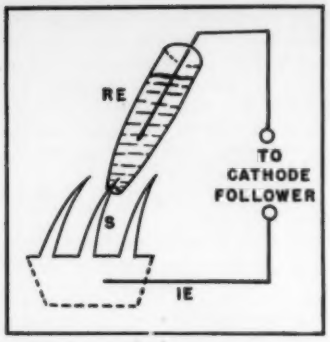

Fig. 1. Diagram of experimental preparation. *S*, chemosensory sensillum on labellum of fly; *RE*, recording electrode; *IE*, indifferent electrode.

diameter) glass tubing was drawn to a tip diameter of about 0.05 mm and filled with the solution under test for its ability to stimulate. The tube containing the solution served both as stimulator and recording electrode; it was connected to a cathode follower by a silver-silver chloride wire inserted into the large end of the tube. An indifferent electrode of silver-silver chloride wire was inserted into the crushed head of the fly. The recording electrode was maneuvered by a micromanipulator until the tip of a single chemosensory hair just penetrated the surface film of the electrode solution. Potential changes between the electrode pair were recorded by means of a push-pull cathode follower, Grass P-4A amplifier, and cathode-ray oscilloscope. A diagram of the experimental preparation is shown in Fig. 1. The impedance looking into the hair is very high, giving problems in voltage division at the grid without feedback compensation. However, it was found as a purely empirical technique that if the ground connection is left off the preparation, capacity coupling between the two grids allows them to seek their own zero grid current level and thereafter to act as high-impedance input devices. The frequency response is much narrowed by this procedure, but since we were interested only in the presence of the spikes, and not in their exact shape, the method was easy and sufficient.

The electric response from a single hair consisted either of one or both of two series of spike potentials, each series clearly originating in a single neuron. The larger spike predominated when the electrode contained salts, acids, or alcohols; the smaller spike predominated when the electrode contained sugar solution with only a trace of electrolyte. Photographs of typical spike potentials as they appear on the oscillograph screen are shown in Fig. 2. There seems to be little doubt that the two types of spikes are associated with the responses of the two neurons having processes extending to the tip of the hair. Since a fluid contact and a trace of electrolyte in the electrode are necessary for electric contact, it has not yet been possible to define the unstimulated state of the two fibers. However, there are indications that both may have a low-frequency spontaneous discharge under conditions approaching zero stimulation.

The sensitivity of both chemoreceptor cells to a variety of chemicals and also to mechanical and temperature changes have been studied in more than 50 preparations (usually with a number of individual chemosensory hairs in each preparation) and four genera of flies (*Phormia, Sarcophaga, Musca,* and *Drosophila*). In a general way, the activity of the chemoreceptor cells resembles many of the characteristics previously reported for neurons that supply mammalian chemoreceptors. Both receptor cells in a labellar hair exhibit rapid adaptation, dropping from a high-frequency discharge to a much lower steady discharge frequency within 1 or 2 sec after a chemical stimulus is applied. The interval between application of the stimulus and the first spike recorded is about 10 msec, or about one-half of the values obtained in responses recorded from neurons associated with mammalian chemoreceptors. Responses are modified by temperature changes, and both receptor cells can respond to mechanical movement of the labellar hair.

Of particular interest is the two-fiber system present in each hair. Stimuli that evoke the smaller spike elicit the positive feeding response (proboscis extension) in the intact fly, and stimuli that evoke the larger spike cause a negative, or rejection, reaction in the intact fly. Thus there is now direct evidence of a peripheral discrimination mechanism in each chemosensory hair, as postulated by Dethier (*3*) on the basis of behavioral studies. A third neuron is associated with each labellar hair, but it does not send a process to the chemosensory tip (*3*). Potentials from a third neuron have not yet been recognized in records made with the present electrode arrangement and types of stimulation applied.

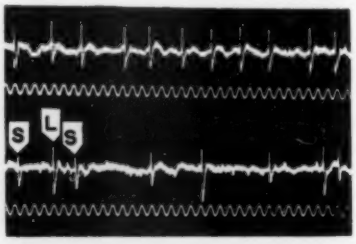

Fig. 2. Upper record: portion of a response to 0.5*M* NaCl; lower record: portion of a response to 0.1*M* sucrose plus 0.1*M* NaCl. Pointers indicate small (*S*) and large (*L*) spikes in the lower record. The time base in both records is 100 cy/sec.

A detailed description of these results has been submitted for publication elsewhere. High-impedance input devices that are designed to extend this method to new preparations and problems are now under construction.

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† This work was made possible in part by a contract between the Medical Division, Chemical Corps, U.S. Army, and Tufts University.

12 April 1955

Geomorphic Evidences of Recent Climatic Fluctuation in the Peruvian Coastal Desert

The observations described in this paper were incidental to geomorphic studies under the auspices of the Office of Naval Research [contract Nonr-583(06)]. Although the data are incomplete, they are believed to be of sufficient interest to be placed on record for the information of archeologists and others to whose work they may be relevant, or who may have opportunity to supplement them. The locations are presented in terms of distances north of Lima, Peru, along the Pan-American Highway, as designated by marker posts along the highway.

On a limestone ridge some 300 ft high, east of the highway near kilometer post No. 716, grooving and fluting by sand blasting are conspicuous. Much of it, however, appears to predate the present. The fluted ledges show separation and dislocation along joints, subsequent to the fluting. Many of the fluted surfaces have been roughened by the superimposition

of rillensteine formed by solutional etching. At a few points the rillensteine, in turn, show some smoothing by renewed sandblasting.

Between kilometer posts 235 and 250, and also at other places, irregular sheets of older eolian sand mantle many of the hill slopes, filling minor stream channels. The sand surface is dark in color and is well stabilized by a litter of rock chips and granules, suggesting immobility for a long interval of time. At several places, however, the older sand is being overridden by drifts of light-colored, fresh eolian sand, which stand in sharp contrast, and indicate renewal of eolian activity.

Although these observations were made in widely separated locations, they are consistent with one another and suggest the following climatic chronology: (i) an earlier episode of vigorous sand movement and sandblasting by wind, under climatic conditions more or less similar to those of the present, though perhaps windier and/or drier; (ii) an interval of decreased wind action, perhaps caused by greater humidity, that permitted stabilization of sand surfaces and modification of wind-fluted surfaces on soluble rock by solution and disintegration; and (iii) a recent shift to increased wind action, which was caused by reduced moisture and/or stronger winds. No evidence concerning the date of the earlier two episodes of contrasted eolian activity was found, but it is surmised that they date back not more than a few thousand years, perhaps much less. The current episode of renewed eolian activity is tentatively correlated with climatic conditions responsible for the recent marked recession of mountain glaciers, as reported by Broggi [in F. E. Matthes, *Trans. Am. Geophys. Union* **27**, 219 (1946)].

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26 May 1955

Prenatal Oxygen Deprivation and Subsequent Specific Behavior Dysfunctions

Recent experimentation (*1*) has indicated that unique anomalies follow physiological insults at specific points in the organism's development. Should the insults (irradiation, nutritional and oxygen deprivation, trauma, and so forth) occur at times when certain systems or tissues are undergoing the greatest differentiation and proliferation, these systems or tissues will show the most severe alteration in structure and function. If this is the case, two methodological uses may be suggested: (i) by properly timing the onset of the insult, information concerning the sequence of developmental events may be obtained; (ii) insults at prescribed periods may aid in describing the structure-function relationship that is inferred from the variations in the behavior of the organism.

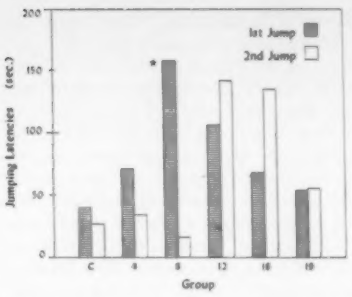

Fig. 1. The performances of the control and experimental groups on the first and second jumping tests. Plotted data are median scores. (The asterisk indicates that the difference between the experimental and control groups is significant beyond the 0.05 level.)

Our study (*2*) applies to this second approach for the purpose of clarifying the function of ablations when incurred in the young organism (chicks), that is, when the opportunities for experience are controlled. We propose that oxygen deprivation at the time of the greatest structural development of the visual-motor system [about 8 days, as indicated by the growth of the optic lobes and related structures (*3*)] would evince dysfunctions in visually dominant behavior.

Five incubation stages were used: 4, 8, 12, 16, and 19 days. Representing these conditions were 12, 17, 6, 12, and 15 chicks, respectively. Eighteen chicks served as controls. Subjects in the experimental groups were deprived of oxygen for the median lethal dose (LD_{50}) by immersion in distilled water at incubation temperature (99.5°F). The LD_{50} was a predetermined period of immersion ranging from 105 min for the 4-day group to 25 min for the 19-day group.

After the chicks hatched, the following measures were made: (i) weight (2nd day); (ii) sensitivity of the optokinetic reflex (7th day); and (iii) jumping performance (two measurements: 4th, 5th, or 6th day, and 11th, 12th, or 13th day, respectively).

An apparatus similar to the one designed by K. U. Smith (*4*) was used for measuring the optokinetic reflex. The drum, 22 in. in diameter, rotated at 4.3 rev/min. The vertical stripes were 2 in. wide. The index of reflex sensitivity was the time for 40 flexures of the head in response to the moving stripes.

A technique reported by Fletcher *et al.* (*5*) was used of measuring the chick's jumping behavior. The animal jumped from a platform 4 in. in diameter from heights starting at 15 in. and rising by 5-in. increments to 60 in. For each chick and for each height latency scores and the maximum height (that height for which the latency score was 360 sec or greater) were recorded. On each of the two jumping days, the subject was isolated from food and brood mates for 2 hr. The incentives for jumping were food and two brood mates.

Based on the developmental schedules of the embryo, we predicted that the 8-day incubation group would show: (i) a reliable difference in jumping behavior as indicated by latency scores; and (ii) inferior reflex sensitivity as indicated by greater time indices.

The graphic representations show the distinctiveness of the 8-day group. These subjects were significantly lower (*6*) ($p < .05$) than the controls at the first jumping test (Fig. 1). However, no reliable differences in performance were found at the second jumping test. The greatest difference (insignificant statistically) was between the control group and the 12-day groups.

On the optokinetic apparatus, only the 8-day groups could be statistically distinguished from the control group ($p < .01$; Fig. 2). No differences in weight were found between the control and experimental groups, nor were obvious anatomical or locomotor defects noted. Incomplete data on other tasks, such as the Fink Arrow Maze (*7*), suggest that the uniqueness of the 8-day group noted in this experiment need not apply to other behavior.

In conclusion, these performance data substantiate the predictions: Variations in visual-motor behavior were reliably affected when oxygen deprivation was incurred at the 8th day of incubation, the period of greatest development of the visual-motor system. Insignificant, but

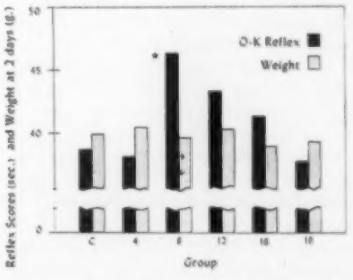

Fig. 2. Time scores on the opto-kinetic apparatus and weight measures on the 2nd day. Plotted data are median scores. (The asterisk indicates that the difference between the experimental and control groups is significant beyond the 0.01 level.)

consistent, differences were found with other experimental groups, possibly indicating the effects of the deprivation on other systems that are not so important in the behavioral tasks used here. A comparison of the performance of the 8- and 12-day groups on the first and second jump suggests the operation of differential effects of early experience.

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6 June 1955

Synthalin A as Selective Mitotic Poison Acting on α-Cells of the Islets of Langerhans

In recent years it has been discovered that the alpha-cells of the islets of Langerhans, which are considered to be the producers of glucagon (HGF), are seriously affected by synthalin A in adult rats, guinea pigs, and rabbits. Observations on the rabbit have revealed that these cells are at times totally destroyed and that they disappear. Sometimes they are partially destroyed or injured (*1–3*). This phenomenon is accompanied by a sharp decrease in the blood sugar level. The beta-cells and the exocrine part of the pancreas do not demonstrate any pathological changes.

The action of synthalin A on the alpha-cells of young animals has not been previously studied. Therefore we tested 20 young albino rats (ages ranged from the first to the fifth day of life) by giving each a single subcutaneous injection of decamethylenediguanidinedichlorehydrate in aqueous solution at 10 mg/kg of body weight (*4*). The animals, including the controls, were sacrificed 12 to 18 hr after injection by decapitation. The abdominal viscera were fixed in Bouin's fluid. Thin paraffin sections were stained by Gomori's chromehematoxylin and phloxin method.

The pancreas of normal 1-day-old rats contains well-defined and relatively large islets of Langerhans. They show the "Mantelinsel"-type, since it is characteristic of the Muridae. The core of beta-cells is surrounded by an incomplete layer of alpha-cells, the covering layer of which often varies in thickness. The beta-cells, especially the granules, in the young and the adult rat are cytologically similar. The granules of the alpha-cells in young animals are coarser and fewer in number in comparison with those in the adult. It was observed that, between the first and fifth days of life, the number of alpha-cells was absolutely and relatively increased through intensive mitotic division. The increase of the beta-cells was substantially smaller. There were many alpha-cell mitoses and few divisions of the beta-cells. The alpha-to-beta relationship changed from 1 to 2.06 on the first day of life to 1 to 1.61 on the fifth day of life. The proportion of alpha-to-beta cells in the adult rat is 1 to 4 or 1 to 5.

After a single subcutaneous injection of synthalin A, the 1-day-old rats did not manifest clinical symptoms. In contrast, the 2- to 5-day-old rats, at a period 12 hr later, exhibited increasing lassitude, shivering, and altered respiration. In none of the young rats treated with synthalin A were the alpha-cells altered; none showed signs of lesions. There were no alterations in granulation, and no hydropic changes or detritus of alpha-cells, which are found in adult rats after treatment with synthalin A.

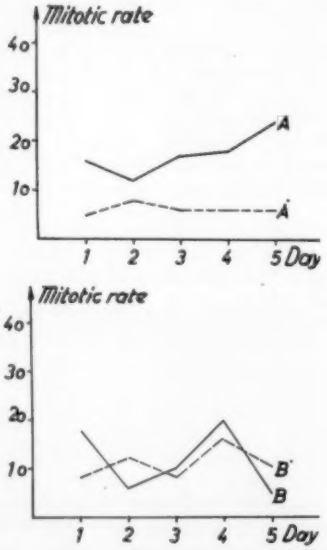

Fig. 1. Above, mitotic rate of alpha-cells in 100 sections through pancreatic islets in rats 1 to 5 days old. (*A*) controls; (A') effect of synthalin A. Below, mitotic rate of beta-cells in 100 sections through pancreatic islets of rats 1 to 5 days old. (*B*) controls; (B') effect of synthalin A.

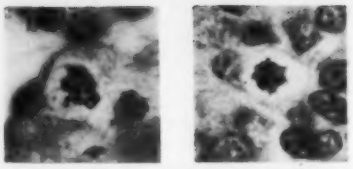

Fig. 2. (Left) Mitotic alpha-cell of 5-day-old rat, control animal, ×700. (Right) Mitotic alpha-cell of 4-day-old rat injected with synthalin A (10 mg/kg), ×700.

In a comparison of the controls and the treated animals, a notable finding concerning alpha-cell mitosis was made—that is, synthalin-treated rats show a significant decrease in mitotic frequency of the alpha-cells, and the remaining mitotic alpha-cells are injured. In contrast, no mitotic divisions of the beta-cells or of the acinar cells of the pancreas were affected either quantitatively or qualitatively. It is interesting to note that the mitotic rate of the acinar cells was much higher than it was in the alpha-cell layer. The rate of beta-cell mitosis in the synthalin-treated rats was nearly the same as it was in the controls. In the treated animals the frequency of the dividing alpha-cells is decreased to 25 percent of the normal on the fifth day of life. The curve of the mitotic activity rose continually from the second to the fifth day of life in the controls. In injected rats the curve remained on a low level (Fig. 1). Microscopic examination of the mitotic figures of the alpha-cells following synthalin treatment revealed a pycnotic degeneration of the late prophase and early-to-middle metaphase (Fig. 2).

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4. This work has been supported by a grant from the Research Corporation, New York.

13 June 1955

Thermal Shock and Tooth Decay

In an article by D. G. and H. A. Pohl (*1*) they state that one of the possible reasons for the increasing incidence of tooth decay is the alternate eating of very hot and cold foods during the same meal. They submit as evidence an experiment in which extracted teeth are subjected to intense thermal shock and then tested by methods that seem to indicate a de-

creased ability to withstand mechanical stress. Hence they feel that structural changes may have occurred decreasing the resistance of teeth to the decaying process.

However, tooth decay is a chemical and not a mechanical process (*2*). If rapid temperature changes in the mouth alter the tooth structure in any way that should increase the susceptibility to decay, experiments indicating the degree of resistance of thermally shocked teeth to chemical attack should be revealing. Possible approaches to gain such information might be the method of Pigman (*3*) or the study of the rate of calcium lost from these teeth in solutions of weak acids or chelating agents.

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20 May 1955

We believe that the suggestions of L. S. Vann regarding use of *in vitro* experiments such as leaching or using Pigman's "artificial mouth" technique (*1*) are excellent. It seems clear that controlled *in vivo* experiments would also be valuable, such as a clear-cut comparison of the caries incidence in white rats subsisting on conventional feed and on a liquid intake of a caries-accelerating fluid only—such as a highly acid fruit juice, or better, a medium rich in free phosphoric acid such as a cola drink (*2*)—with, say, 50 animals subjected first to severe repeated thermal shocks at their teeth and another 50 held as controls, and a third group of 50 fed like food but only water as liquid intake to serve as background control.

One would expect that within about 6 months of such feeding, differences in caries incidence would be worth examining. Further results, unaccelerated by acid liquid intake, using normal diets and the effect of thermal shock alone, which may require longer times and perhaps larger animal group populations, would of course be even more valuable. If, as a result of such *in vivo* experiments, corroboration is found for the earlier demonstrated indication (*3*) that thermal shock noticeably affects teeth as determined *in vitro* using extracted teeth, then further work of clinical character would be indicated. Failing such verification, the subject hypotheses should be regarded with much skepticism. The opportunity and facilities for so testing the hypothesis are unfortunately not now available to me.

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10 August 1955

Light-Dependence of Fluorescence of Solutions of Cigarette Smoke

For several decades tobacco has been suspected of being a cancer-inducing substance to man. Currently tobacco smoke is being discussed as a cause of the alarming increase of cancer of the human bronchus. In the 1930's Roffo reported the production of cancers in rabbit ears upon the application of tobacco tar (*1*) and more recently Wynder, Graham, and Croninger have produced cancers in mice following painting of the skin with condensates of cigarette smoke (*2*).

In the difficult and important search for carcinogens in tobacco smoke, we have studied fluorescence phenomena (*3*), but a role for 3,4-benzopyrene has not yet been indicated. Roffo and Correa thought they had spectrographic evidence of benzopyrene in tobacco tar (*4*).

Recent investigations show that highly reactive, radical-forming substances are often carcinogenic (*5*). Such unstable, easily excited compounds of limited lifetime must be considered in connection with tobacco smoke. The stability of fluorescence of solutions of tobacco smoke in benzene or petroleum ether was therefore examined (*6*).

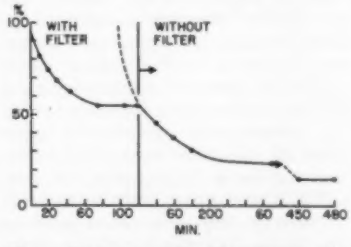

Fig. 1. Decrease of the fluorescence of a solution of cigarette smoke in benzene following irradiation with ultraviolet light. Ordinate: Fluorescence-intensity, in percentage. Abscissa: Time of the ultraviolet irradiation, in minutes (Hanauer-Quartz-Analysenlampe, distance 30 cm).

Smoke from a cigarette was passed into a wash bottle containing optically clear benzene, and the effects of light on the fluorescence intensity of the solutions were determined with a Beckman quartz spectrophotometer with excitation at 365 mμ and using a fluorescence standard of 0.1 mg% quinine sulfate in 0.1*N* H_2SO_4.

In daylight, a decrease in fluorescence to 40 percent of the initial level was seen after 1 to 10 days, depending on the light intensity. In the dark, the initial fluorescense remained stable. The decrease noted occurred under oxygen or nitrogen atmospheres, indicating that oxidation is probably not involved. Irradiation with a Hanauer quartz lamp at 30 cm without filter reduced the fluorescence to 10 percent of the initial value in 3 hr. The decrease was irreversible and first order in character; two different time constants were suggested (Fig. 1). Stable and unstable components of the fluorescing material are thus indicated, the latter accounting for 90 percent of the initial fluorescence. Control tests showed that the 6-hr irradiation with the quartz lamp did not affect the fluorescence of the quinine standard or of solutions of pyrene or of 3,4 benzopyrene.

The chemical nature of the indicated unstable compounds is not known, and it is not known whether they are carcinogenic. The possible interest of unstable compounds must be remembered in the search for carcinogens in tobacco smoke, and it is possible that tobacco tars may not preserve the full efficacy of compounds initially present in tobacco smoke.

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6. This work was supported by the Deutsche Forschungsgemeinschaft. A more detailed report of these investigations will be published in the "Arzneimittel-Forschung."
* From the Chirurgischen Universitätsklinik, Freiburg, Germany.

28 April 1955

Human happiness depends chiefly upon having some object to pursue, and upon the vigor with which our faculties are exerted in the pursuit.—JOSEPH PRIESTLEY, *in the preface to History of Electricity.*

Book Reviews

Molecular Vibrations. The theory of infrared and Raman vibrational spectra. E. Bright Wilson, Jr., J. C. Decius, and Paul C. Cross. McGraw-Hill, New York–London, 1955. xi + 371 pp. Illus. $8.50.

The book on molecular vibrations by Wilson, Decius, and Cross has been awaited with keen interest by molecular spectroscopists throughout the world. The fundamental contributions that the authors have made to this subject led us to expect a presentation of unique qualities, and we are not disappointed in this expectation.

Up to the present time, there has been no detailed and comprehensive presentation available of the theory of molecular vibrations, of the methods of solution of the secular equations and the applications of this theory to an understanding of infrared and Raman vibration spectra. Such a presentation is provided by the authors in the present book.

The central problem discussed in this book is the derivation of the normal vibrations of a polyatomic molecule. The theory is developed with mathematical rigor and elegance. Starting from the simplest cases step by step, more and more complicated and general cases are dealt with. The powerful tools of group theory and matrix algebra are introduced, explained, and used in the derivations. This is a difficult subject to explain to the student. The authors have been notably successful in arriving at a satisfying presentation that is as readable as one can expect for such a complex subject. However, by the very nature of the subject, the book, particularly in the later parts, is not easy to read.

In addition to the solution of the vibration problem (both in classical mechanics and wave mechanics), the book gives derivations of selection rules, discussions of the anharmonic terms in the potential energy, the isotope effect, Fermi resonance, and the problem of several equilibrium positions. With regard to some of these items, particularly the anharmonic terms, one might have wished for more detail. The theorems derived in the book are illustrated in Chapter 10 by a detailed discussion of their application to the benzene molecule.

The main part of the text is supplemented by 16 appendixes, which present such things as character and correlation tables of the point groups, proofs of certain theorems, and, in the last appendix, a brief treatment of rotation and rotational selection rules.

All those interested in the fundamentals of molecular spectroscopy and all those who want to carry out calculations of force constants and potential functions from observed vibrational frequencies should turn to this book for guidance. They will find in it an authoritative and complete presentation written on a very high level.

G. Herzberg

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National Research Council, Canada

Numerical Methods. Andrew D. Booth. Academic Press, New York; Butterworths, London, 1955. vii + 195 pp. Illus. $6.

This new book on numerical analysis is based on a series of lectures given by the author at Birbeck College, London. Although it approaches its subject from the point of view of a person interested in learning the art and science of programming for an automatic digital computer, classical material is presented on virtually all the subjects treated. The book is peppered with "cautions and precautions," desirable warnings to students who have not experienced the hazards implicit in letting the machine obey orders that have not been thoroughly and carefully and explicitly formulated or follow computational designs that ignore some of the more elusive hypotheses necessary for the validity of the theorem.

The book is rather more ambitious in its coverage than most recent books on the subject, including treatments of the nature and purpose of numerical analysis, tabulations and differences, interpolation, numerical differentiation and integration, summation of series, ordinary and partial differential equations as well as integral equations, linear and nonlinear algebraic equations, approximating functions, and Fourier synthesis and analysis. Although the initial chapter devotes less than two pages to a discussion of precision, accuracy, and errors, there is a treatment of error estimates for most of the methods presented; and there is constant concern for methods of checking solutions.

The topics listed here cannot convey the wealth of detail covered. For example, the chapter on partial differential equations devotes only 31 pages to a set of topics including the classification of partial differential equations, methods for the numerical solution of parabolic and hyperbolic equations in two and in more than two variables, the method of characteristics, multipoint boundary conditions and elliptic partial differential equations, practical aspects of the relaxation method, Monte Carlo methods, and "more complicated" partial differential equations. This extraordinarily compact coverage is achieved partly by simplification and generalization from the classical treatment but largely by handling only the salient features of the problem and expecting the reader to seek fuller information from the bibliography (which is given for each chapter as well as for the book as a whole).

The detailed chapter bibliographies should prove very helpful. The author's objective is to present only the mathematical basis of his subject. He presents essentially a guide to numerical analysis, including detailed computation only in the chapter on simultaneous linear equations where the purpose is to illustrate the sort of behavior that may be expected in a calculation "rather than any detailed form of layout."

If there are some subjects (such as the rather specially oriented chapter on Fourier synthesis and analysis) that seem to be included more because the author is expert in the subject than because of their general importance, and if there are lapses from the most complete scholarly precision, such as the reference to Monte Carlo methods as methods that make use of the theory of games, the reader can forgive the author; for the book provides a useful and stimulating guide to a subject that has changed so rapidly during the past decade that the potential user of high-speed machines is sorely in need of informed and understanding help in finding his way through the maze of new literature on the subject.

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Electrons, Atoms, Metals and Alloys. William Hume-Rothery. Philosophical Library, New York; Iliffe & Sons, London, ed. 2, 1955. 387 pp. Illus. $10.

This is an excellent book, which aims at giving a qualitative understanding of the cohesion and the electronic properties of solids, particularly of metals and alloys. The book consists of a dialog be-

tween an older metallurgist (that is, before quantum theory) and a young scientist. In general such a treatment would be difficult to sustain for more than, say, 50 pages, but the author has done a wonderful job, giving the older metallurgist just the right amount of curiosity and intelligence.

The book is well organized and starts by examining the physical principles upon which quantum mechanics is based; quantum theory is then described, and the periodic table is examined. The behavior of electrons in a solid is then considered, with free electrons, Brillouin zones, and electron density versus energy curves being examined. Various types of cohesion are then considered: molecular crystals, valence crystals, and metals. Next the electronic differences among metals, insulators, and semiconductors are described. Atomic and ionic radii are then discussed. Then a thorough study of the cohesion of univalent and, finally, of the transition metals is given. In the case of the transition metals the treatment includes an accurate and up-to-date discussion of ferromagnetism. The last major section of the book deals with alloys. Since this is a field in which the author has made notable contributions, one hopes for something rather special. The expectations are fully realized, for all of the various results produced by electron to atom ratio, size, and the electrochemical factor are described with illustrations.

It can be seen that the book covers a tremendous amount of material, but the writing is skillful and careful so that the net result is to instruct rather than to confuse. A very useful feature of the book is a good set of references for further reading.

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Political Systems of Highland Burma. A study of Kachin social structure. E. R. Leach. Harvard Univ. Press, Cambridge, Mass., 1954. xii + 324 pp. $7.

A brief review can hardly do justice to a major contribution to theory in any field. The judgment "major contribution" should not be lightly bestowed, and certainly in the case of *Political Systems of Highland Burma* many anthropologists would dissent. I shall therefore restrict my comments to assertions of the book's importance—criticisms, of which I have many, will be reluctantly foregone.

Several of the most crucial aspects of anthropological theory are treated and skillfully interrelated by Leach. His work is not an ethnography but a remarkably keen analysis of varieties of social structure in the still remote mountainous reaches of northeastern Burma. But social structure for Leach is not a topic exclusively devoted to kinship or political algebra. Starting firmly with the contrasting ecological bases of three subregions within the general area, he seeks to isolate and construct conceptual models of the political organization of the "simple" Kachin and the "sophisticated" Shan. This in itself would represent a contribution only in the degree of its elaboration of detail, for the gross dichotomy involving the generally lowland dwelling, irrigated rice cultivating, territorially organized Shan (T'ai) and the generally highland dwelling, shifting cultivators with kinship-oriented societies, in Leach's case the Kachin, has long been utilized either implicitly or explicitly by Chinese and British rulers and many of the literate travelers who left commentaries on the area of which this present volume treats a small part.

But the genuine contribution of Leach is twofold: he has constructed his models with unusual vigor, and he has substituted a trichotomy for the earlier dual categorization. He still retains Shan with no apparent amendment of his predecessors' work and he similarly utilizes the concept of the simple political organization, although he describes it in terms of a model of *gumlao*, the idealized Kachin structure based on egalitarian kinship. The innovation is the insertion of a transitional sociopolitical type, *gumsa*. This, stripped to essence, I would call "stratified kin society," although Leach does not use this terminology.

While Leach, trained in British social anthropology, nowhere explicitly commits himself to a general evolutionary view of culture (he would say "society") and although he explicitly seeks the dynamic of change outside the system with which he is concerned (p. 212), other anthropologists may wish he had gone much farther with the implications of his work. Briefly, this would have meant adding to the *general* theory of the evolution of class-stratified society and the state.

Here, then, is the locus of my enthusiasm. As Leach himself points out, none of the great 19th-century evolutionists in social science, Morgan, Engels, Spencer, and so forth, "discussed in detail—still less observed—what happened when a society in Stage A changed into a society at Stage B; it was merely argued that all Stage B societies must somehow have evolved out of Stage B societies" (p. 283). The work that might fill this lacuna is still quite scanty, but I find it incredible that, although Leach cites the pioneer work of Fortes and Evans-Pritchard, *African Political Systems* (1940), he makes no conspicuous use of his own excellent report on various peoples of Sarawak, *Social Science Research in Sarawak* (1950).

Leach, himself, ends on an equivocal note. He finds the transitions from kin to stratified kin to state organization a difficult one and wonders in print how other peoples have dealt with similar situations. I apparently am more confident of the richness of comparative data presently in hand. But, regardless of the ultimate determination of the issue, it must be admitted that a scientific approach to basic questions of the evolution of social classes and state organization is an exciting reality demonstrated by this book.

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An Introduction to Stochastic Processes with Special Reference to Methods and Applications. M. S. Bartlett. Cambridge University Press, New York, 1955. xiv + 312 pp. Illus. $6.50.

This book, based on the author's lecture notes at the University of North Carolina, is the first of a proposed three-volume work on the theory and application of stochastic processes. It is an introductory work addressed to the applied mathematician and statistician and presents the elementary methods and statistical techniques involved in stochastic processes. A detailed treatment of the basic mathematical theory and applications in physics are the topics for the forthcoming two volumes, both by J. E. Moyal.

A stochastic process, aside from its precise mathematical formulation, is initially defined by Bartlett as some possible actual process in the real world that has a random or stochastic element in its structure. After a brief introduction into some of the basic concepts of statistics and probability, the author introduces discrete and continuous Markov processes. He then deals with the random walk, the theory of queues, the application of stochastic processes to population growth and epidemic models. Two chapters are devoted to limiting stochastic operations and stationary processes. Prediction, communication theory, and the statistical analysis of stochastic processes make up the latter portion.

Although Bartlett does not always conform to the commonly accepted notation of the theory, his volume is a model of clarity and organization. On the whole this book is to be highly recommended for the applied mathematician and statistician who like a sound but not too abstract treatment of the theory of stochastic processes. For research workers in the natural, physical, and social sciences, who

have a strong mathematical background, this book provides a means of becoming acquainted with some applications of the theory to their respective fields.

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The Lipids. Their chemistry and biochemistry. vol. II, **Biochemistry.** Digestion, absorption, transport and storage. Harry J. Deuel, Jr. Interscience, New York, 1955. xxvi + 919 pp. $25.

This comprehensive treatise on *The Lipids* was originally planned to be published in two volumes but has been expanded to three. Volume I, *Chemistry,* appeared in 1951. Volume III, which will include biosynthesis, metabolism, and nutritional value, is yet to come.

Volume II covers digestion, absorption, transport, and storage of lipids with literature citations up to and including 1953. Its seven chapters are "Introduction," "The digestion and absorption of fats in the gastrointestinal tract," "The digestibility of fats," "The digestion, absorption, and digestibility of lipids other than fats," "Blood lipids," "The occurrence of lipids in the animal as a whole," and "Lipid distribution in specific tissues and in their secretions."

The chapter on digestion and absorption of fats in the digestive tract includes very complete discussions of the various fat-splitting enzymes and the chemistry of the bile acids and their role in fat digestion and absorption. The pathways of fat absorption in animals are thoroughly discussed, along with the physiological and chemical factors that affect them. Chapter III reviews the important concept of "digestibility of fats." The numerous experimental methods of investigating this concept are described, and there is an excellent résumé of published data on digestibility. An unusual feature, Chapter IV, is a 97-page review of digestion, absorption, and digestibility of *lipids other than fats,* including such diverse types of compounds as phospholipids, sterols, and the several fat-soluble vitamins—subject matter that is covered only briefly in the usual textbook. Even to one who is familiar with this field, it was astonishing to see more than 600 references cited in this chapter alone.

Chapter V on blood lipids, 170 pages, is by far the most exhaustive treatment of this subject to date. It should be of great value to those who are conducting investigations related to this subject. Subjects covered include chemical nature, qualitative and quantitative relationships, factors affecting blood levels, and pathological considerations, including the currently important subject of arteriosclerosis.

Total body lipids are considered, in Chapter VI, as originating from the diet and from synthesis from protein and carbohydrate. Methods are described for determining total lipids of human and other animal bodies. Fatty livers and the lipidoses are included in the discussion of abnormal lipid deposits. Chapter VII includes a vast fund of information on specific tissue lipids, a coverage somewhat similar to that in Bloor's monograph published in 1943 but, of course, including data published since that time.

After reading the first two volumes of *The Lipids,* one is deeply impressed by the comprehensive treatment of the subject matter. In volume II alone nearly 4000 authors are cited with about an equal number of literature references. One is, in fact, amazed that so many investigators have contributed to this field. Indeed, the citation of so many references may be confusing. On the other hand, no author could be expected to evaluate critically and justly all that has been published. The graduate student entering the field will be impressed with the confusion of data and ideas on these several subjects, and yet, no doubt, if he will study the old and the new citations on any given subject, he will learn much from the experimental methods that are covered in this volume in more detail than usual and will certainly be in a position to profit by the mistakes of those who have gone before.

The author is to be congratulated on his audacity in having attempted such a comprehensive treatise on this subject and for the general excellence of his results. This work will undoubtedly be an important milestone in this branch of science and will serve as an invaluable reference book.

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Theories Relativistes de la Gravitation et de l'Electromagnetisme. Relativite Generale et Theories Unitaires. A. Lichnerowicz. Masson, Paris, 1955. xii + 298 pp. Illus. F. 2800.

A. Lichnerowicz is, while still young, a recognized leader in the difficult mathematical theories that have blossomed out of the classical tensor calculus of Ricci and Levi-Civita. In the present volume, which embodies his lectures of the last 2 years at the Collège de France, he applies these theories to what is called the unitary problem. The treatment of the electromagnetic field in tensor form, on the one hand, and the relativistic solution of the two-body problem, on the other, are quite generally known, but it is probably not recognized outside the circle of the specialists that there exists as yet no final "unitary" theory leading to the equation of a gravitational and electromagnetic field.

The first part of this volume is an advanced treatment of the mathematics of general relativity, including some new results obtained by the author and his research students. The second part is devoted to two major movements in the contemporary advance toward a unitary field theory: one, labeled the Jordan-Thiry theory, calls to aid the greater potentialities of a five-dimensional space; the other, the Einstein-Schrödinger theory, introduces an affine connection that forsakes the symmetry of the classical "gammas." Generalizations of the wave-propagation theory contained in Hadamard's famous lectures on the Cauchy problem are made throughout the book and contribute clarity and elegance.

This book, needless to say, is not meant for the general public; it is a scholarly presentation of some of the most recent gropings toward a unitary theory, which every worker in the field will wish to ponder. The printing is excellent; the index may be (we are not sure) a product of the tongue-in-cheek humor of the French mathematical school.

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La Mécanique au XVII^e Siècle (des Antécédents Scolastiques à la Pensée Classique). René Dugas. Bibliothèque Scientifique 26, Philosophie et Histoire. Dunod Editeur, Paris 6, 1954. 620 pp. Illus.

The author of this book published in 1950 an *Histoire de la mécanique,* in which the major ideas of the science of mechanics, both statics and dynamics, were traced historically from antiquity to the present; that book had the unique virtue of combining into a single study a history of the ideas of both classical and quantum mechanics. It might, therefore, seem as if the present book were merely an expansion of the section of the former work dealing with the 17th century, but this is not the case at all. Great as the merits of the former work were, it suffered from the fact that the author had not made much use of the scholarly efforts in the history of science in the last three-quarters of a century, much of which has been devoted to elucidating the historical development of mechanics. The present study shows the same familiarity with the primary material as the previous one, but the whole book is enriched by the fact that the author does now take into consideration the impor-

tant secondary and explanatory literature.

Since the 17th century was the time in which the concepts of classical physics were clearly formulated, Dugas' excellent book has a strategic importance for our understanding of physics itself. It deals with the work of great intellectual giants —Kepler, Stevin, Galileo, Descartes, Huygens, Newton, Hooke, Leibniz—and enough information is supplied about the mechanical theories in antiquity and the Middle Ages to enable the reader to set the theories of the 17th century in proper perspective. Although Dugas uses the excellent method of allowing his main participants to speak for themselves, he manages to convey the spirit of invention that characterizes creative work in science, and he shows the delicate connections between brute experience, contrived experiments, logical formalism and mathematics, hypothesis and intuition, and even metaphysics.

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Traité de Zoologie: Anatomie, Systématique, Biologie. vol. XII, **Vertébrés:** Généralités, embryologie topographique, anatomie comparée, caractéristiques biochimiques. Pierre P. Grassé, Ed. Masson, Paris, 1954. 1145 pp. Illus. Paper, F. 9800; cloth, F. 10550.

Although it is primarily devoted to vertebrate morphology, this volume departs from the usual treatment in two obvious respects. Novel inclusions are represented by the two short concluding chapters, one on vertebrate chromosomes (Matthey), the other on biochemical features of vertebrates (Florkin). On the other hand, several missing topics such as adult digestive and respiratory systems, endocrines, and musculature (to be treated in five subsequent volumes devoted to the various vertebrate classes), prevent this volume from serving as a complete comparative morphology textbook.

Vertébrés consists of a series of authoritative chapters contributed by Belgian, French, and Swiss authors. A short introductory chapter by Brien and Dalcq stresses the need for understanding the dynamic developmental processes resulting in adult form, since viable inherited changes in patterns of development represent "amendments to the laws of development" underlying evolutionary change. The authors then proceed to brief considerations of general features of early vertebrate development, adult morphology, and general aspects of vertebrate evolution. A well-illustrated section on comparative vertebrate embryology by Dalcq and Pasteels follows, and, where possible, the descriptive details are based on the dynamic relationships, such as relative movements and inductive interactions, among embryonic parts.

Most of the remaining chapters in this volume are devoted to detailed comparative accounts of the morphology and evolution of vertebrate organs and systems. They include the central and peripheral nervous systems (Cordier), the eye (Rochon-Duvigneaud), statoacoustical (Cordier and Dalcq) and olfactory (Gérard) organs. Moreover, the skeletal system is considered in several chapters, one on the cranium (Piveteau) and several by Devillers on the vertebral column, ribs, sternum, and paired appendages. The histochemist, Lison, contributes a chapter on the teeth, in which he considers their comparative histogenesis and histology and gives a short discourse on their evolution. This is followed by detailed chapters on the circulatory (Stephan) and urogenital (Gérard) systems.

Literature citations following each chapter vary in completeness; a detailed appendix facilitates the search for specific topics.

Vertébrés, although it is well written, illustrated, and indexed, may not find its way into many private libraries because of its high price and because its complete usefulness depends on its supplementation by the remaining volumes of the series.

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Geology in Engineering. John R. Schultz and Arthur B. Cleaves. Wiley, New York; Chapman and Hall, London, 1955. ix + 592 pp. Illus. $8.75.

There has been a notable shortage of books that treat the application of geology to civil engineering. As a consequence *Geology and Engineering* should be popular as a textbook for introducing engineers to the aspects of geology that are indispensable to sound engineering and as a reference for engineering geologists and practicing engineers.

The wide experience of the authors in the fields of teaching and practicing geology is reflected both in the comprehensive quality of the subject matter and illustrations and in the judicious selection of topic sequences and reference material. There are 22 chapters, the first of which introduces the engineer to the development of the science of geology and its relationship in more recent time to civil engineering.

Following this introduction are 12 chapters dealing rather generally with the engineering significance of minerals, rocks, geologic structure, subsurface water, weathering, erosion, desert land forms, shore lines and beaches, frost action, landslides, volcanoes, and earthquakes. Among these the chapter on frost action is the first good discussion in a textbook of this type of the engineering problems related to perennially frozen ground. Such features as permafrost, active layer, talik, thermal regime, pingo, frost blister, slud and zero curtain should arouse the curiosity of students and practitioners alike and should be studied carefully for their importance in arctic engineering projects.

Chapter 14, "Historical geology," a convenient division mark between the earlier and subsequent topics, might be regarded by some readers as superfluous to the book. However, in the second paragraph the authors make this statement, which might well have been placed in Chapter 1, and which budding engineering geologists should heed if they covet the respect of engineers: "the lengthy elaboration of paleontological and historical data in geologic reports intended primarily for civil engineers has perhaps done more than anything else to discourage the application of geology to civil engineering." The word *perhaps* in the foregoing quotation could be deleted safely.

Chapters 15 and 16 discuss the indispensability of geologic maps and sections and aerial photography as implements for obtaining complete predesign information. Chapter 17, "Soil mechanics," by E. J. Yoder, is a commendable discussion of the engineering classifications and properties of soils and their behavior under various conditions of engineering use. Chapter 18, "Subsurface exploration," may be criticized for devoting only one-fourth of its pages to the conventional and more reliable methods of exploring foundations by small- and large-diameter core borings, while three-fourths of the discussion is given to geophysical methods which, although useful, are limited in their reliability.

The last four chapters conclude the book with discussions on dams and reservoirs, tunnels, highways and airfields, and concrete aggregates; from the viewpoint of the engineering geologist these chapters constitute the main structure supported by the foundation of the preceding chapters of the book.

Weaknesses that are unavoidable in a work of this magnitude are limited chiefly to certain generalizations that should be modified in the interest of students. An example is the statement on page 91 that "Joints oriented approximately at right angles to the working face present the most unfavorable condition." Although this observation is correct insofar as it applies to quarrying or tunneling, the exact opposite is true with respect to a

preferred orientation for joints when sealing dam foundations against leakage is involved.

Should engineering geologists be inclined to consider the authors stingy in their development of the heavier subjects such as soil mechanics, subsurface explorations, and dams and reservoirs, they are reminded that the purpose of the book as expressed in the preface is that it should meet the needs of engineering students primarily, and that "an even greater need for a book acquainting geologists employed in engineering work" continues. With the impressive array of geologists who are qualified to contribute a treatise on engineering geology, it is to be hoped that such a contribution will appear at an early date as a supplement to Schultz and Cleaves' good work.

ROBERT H. NESBITT
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Mathematics for the Chemist. Mathematical analysis for chemists, physicists, and chemical engineers. G. J. Kynch. Academic Press, New York; Butterworths, London, 1955. vii + 356 pp. Illus. $4.80.

The author states a threefold purpose for the book: to meet the needs of students taking Honours Courses in English universities; to provide a textbook on the applications of mathematics to chemical problems; and to serve as a reference book of mathematical information.

The subject matter covered includes approximate solution of equations; sequences and limits; differentiation; rational, circular, exponential, logarithmic, and hyperbolic functions; elementary analytic geometry; integration; series; complex numbers; differential equations; determinants; vectors; partial differential equations. Illustrative material in the text and numerous problems at the end of each chapter are largely from the field of chemistry. It is regrettable that the author found it necessary, because of space considerations, to omit chapters on numerical integration and on probability and error theory.

With such a wide range of subject matter to cover, the book could hardly be considered as a primary source of information. However, it should serve excellently as a textbook for a refresher course in mathematical techniques, for which purpose it is highly recommended. It should be especially valuable as a handy reference book for chemists, chemical engineers, physicists, and others who apply mathematics to physicochemical problems.

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Transform Calculus with an Introduction to Complex Variables. E. J. Scott. Harper, New York, 1955. ix + 330 pp. Illus. $7.50.

This book is written strictly for the engineer, physicist, and chemist. Its purpose is to show how problems are solved by the use of transforms. Although a fair amount of theory is included, it is there only because it is necessary for expounding the technique. The preface explains that the book is an outgrowth of lectures given at the University of Illinois to advanced undergraduates, mostly from the fields of engineering, physics, and chemistry.

The first chapter of 46 pages, including five pages of problems, is devoted to complex variables, with limits and analyticity, the Cauchy theorem, Taylor and Laurent series, singularities, residues, and contour integration. The next two chapters (34 pages) discuss the Laplace transform and its inverse. The succeeding eight chapters consider, in turn, ordinary differential equations, partial differential equations, integral equations and some special functions, partial differential equations again, and finite transforms. In appendixes are given a list of references and tables of operations, of Laplace transforms, of finite sine transforms, and of finite cosine transforms. Finally there is a short index of just over a page.

The exposition rests primarily upon the discussion of special problems: deflection of beams, motion of a particle, small oscillations, vibrations, networks, heat flow, radiation, diffusion, and others. There is a brief discussion of stability in the chapter on matrix algebra. Each chapter is followed by three or four pages of problems for solution.

Mention might be made of an unfortunate phraseology on page 256, second paragraph. The first sentence reads: "Now the series in the bracket is *divergent* for all values of x, since by the Cauchy ratio test . . ."; the italics are Scott's and the dots signify an assertion. Presumably the following is meant: "Since . . . therefore by the Cauchy ratio test the series in the bracket is *divergent*." On page 51, second line before the end of the section, there appears to be a superfluous "and."

On the whole the book seems well suited to its purpose. A considerable amount of material is presented in a readily comprehensible manner. Thus the engineering student who is interested in gaining facility with a particular tool can get some experience in using it, some feeling for the variety of possible transforms, and some appreciation for the principles upon which the method is based.

However, it appears to me at least that the utility of this particular tool is decidedly on the wane. This makes no judgment of the importance of operator theory as a branch of mathematics, which is, in any case, not the concern of the book. But with the increasing use of high-speed computing machinery, and the use is increasing at a phenomenal rate, the notion of what constitutes a "solution" to a problem is undergoing a radical change. To be able to express a function, say the solution of a differential equation, in terms of tabulated functions, even elementary functions, is not *ipso facto* advantageous. If numbers are required it may be much easier to apply standard numerical procedures to the differential equation itself than to attempt to evaluate the "closed form" expression for the solution. And if one is interested in the qualitative properties of the solution, then again one may be better off to go back to the differential equation and apply principles of the qualitative theory of differential equations. In either case the attempt to apply transform theory or any other device for obtaining the solution in some kind of closed form may turn out to be wasted effort even when it is formally successful.

One may object that not every physicist or engineer will have a UNIVAC or 701 at his fingertips, and this is certainly true. But many do and many more will have, or if not one of these, then a 650 or other more modest, but still fairly adequate, computing equipment. There is an ILLIAC at Scott's own university.

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Medical Uses of Cortisone. Including hydrocortisone and corticotropin. Francis D. W. Lukens, Ed. Blakiston–McGraw-Hill, New York, 1954. xiii + 534 pp. Illus. $7.50.

"Five years have passed since the anti-inflammatory effect of cortisone was announced and since this hormone was made available to physicians. During this period extensive investigations have been made of the action and uses of cortisone, hydrocortisone, and corticotropin. . . . Accordingly, the judgment of a group of physicians with wide experience in the use of adrenal hormone therapy has been assembled in one volume. The authors not only cite the ample literature in their several fields, but present their own conclusions as to the place of these hormones in various diseases."

The 15 chapters, representing the work of 29 contributors, are "Physiology of the adrenal cortex," "Pharmacologic aspects of adrenocortical hormones in man, and their effects in adrenal insufficiency," "Rheumatoid arthritis and

other rheumatic or articular diseases," "Rheumatic fever," "Other collagen diseases," "Asthma and rhinitis," "Allergic reactions to therapeutic agents," "Diseases affecting the skin," "Granulomas: pulmonary granulomatoses, pulmonary fibrosis, other pulmonary conditions," "Infections," "Eye diseases," "Gastrointestinal diseases," "Blood diseases and malignancy," "Diseases of the kidney," and "Neuropsychiatric disorders."

New Books

Catalysis. vol. III, Hydrogenation and Dehydrogenation. Paul H. Emmett, Ed. Reinhold, New York; Chapman & Hall, London, 1955. 504 pp. $12.

Determination of Organic Structures by Physical Methods. E. A. Braude and F. C. Nachod, Eds. Academic, New York, 1955. 810 pp. $15.

Principles of Nuclear Reactor Engineering. Samuel Glasstone. Van Nostrand, New York, 1955. 861 pp. $7.95.

Linear Feedback Analysis. J. G. Thomason. McGraw-Hill, New York; Pergamon, London, 1955. 355 pp. $8.50.

Montaña y los Origenes del Movimento Social y Cientifico de Mexico. Jose Joaquin Izquierdo. Ediciones Ciencia, Mexico, 1955. 442 pp.

The Life and Work of Sigmund Freud. Years of Maturity, 1901–1919. vol. 2. Ernest Jones. Basic, New York, 1955. 512 pp. $6.75.

Science and Christian Belief. C. A. Coulson. Univ. of North Carolina, Chapel Hill, 1955. 127 pp. $2.50.

Science News No. 36. A. W. Haslett, Ed. Penguin, Baltimore, 1955. 128 pp. $0.65.

Operationism. A. Cornelius Benjamin. Thomas, Springfield, 1955. 154 pp. $4.

Production of Heavy Water. National Nuclear Energy Ser. Division III, vol. 4F. James O. Maloney, George F. Quinn, and Harold S. Ray, Maxwell L. Eidinoff, George G. Joris, Ellison Taylor, Hugh S. Taylor, and Harold C. Urey. McGraw-Hill, New York, 1955. 394 pp. $5.25.

A History of Dermatology in Philadelphia, including a Biography of Louis A. Duhring, Father of Dermatology in Philadelphia. Reuben Friedman. Froben, Fort Pierce Beach, Fla., 1955. 556 pp. $10.

Universe, Unlimited. A new concept of atomic structure with a unification hypothesis. Hugh Sloss. Vantage, New York, 1955. 197 pp. $2.75.

Microbiology. Ernest Gray. Philosophical Library, New York, 1955. 175 pp. $3.75.

Horner's Dictionary of Terms Used in the Theory and Practice of Mechanical Engineering. Staton Abbey, compiler. Philosophical Library, New York, ed. 7, 1955. 538 pp. $6.50.

Experimental Electronics for the Beginner. Lewis G. Blevins and Leonard R. Crow. Universal Scientific, Vincennes, Ind., 1955. 360 pp. $3.50.

Lectures on Functions of a Complex Variable. Wilfred Kaplan, Ed. Univ. of Michigan, Ann Arbor, 1955. 435 pp. $10.

The Metallury of Zirconium. Benjamin Lustman and Frank Kerze, Jr., Eds. McGraw-Hill, New York, 1955. 776 pp. $10.

A Catalogue of the American Hesperiidae indicating the Classification and Nomenclature Adopted in the British Museum. pt. IV, Hesperiinae and Megathyminae. W. H. Evans. The Museum, London, 1955. 499 pp. £4.

The Luminescence of Biological Systems. Proc. Conf. on Luminescence, 28 Mar.–2 Apr. 1954. Frank H. Johnson, Ed. American Association for the Advancement of Science, Washington, 1955. 452 pp. $7., AAAS memb. $6.

Antimetabolites and Cancer. A symposium. Cornelius P. Rhoads, Ed. American Association for the Advancement of Science, Washington, 1955. 312 pp. $5.75, AAAS memb. $5.

Advances in Experimental Caries Research. A symposium. Reidar F. Sognnaes, Ed. American Association for the Advancement of Science, Washington, 1955. 236 pp. $6.75, AAAS memb. $5.75.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Disposal of Government-Owned Community at Oak Ridge, Tenn. Hearing before the *ad hoc* subcommittee on disposal of government-owned communities of the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Fourth Congress, first session. 148 pp. *Disposal of Government-Owned Community at Richland, Wash.* Hearings before a subcommittee on disposal of government-owned communities of the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Fourth Congress, first session. 112 pp. The Committee, Washington, 1955.

Appraisal of Conservation Purpose and Policy. G. B. Gunlogson. North Dakota Inst. for Regional Studies, Fargo, 1954. 12 pp.

Annual Report, 1 June 1954–31 May 1955. General Mills, Inc., Minneapolis 1, 1955. 23 pp.

Vegetative Propagation of Slash Pine. Station Paper No. 54. Francois Mergen. Southeastern Forest Expt. Sta., Asheville, N.C., 1955. 63 pp.

Numeros Indices Agricolas. No. 4, 1954. Instituto Nacional de Investigaciones Agronomicas, Madrid, 1955. 9 pp.

Proceedings of the National Institute of Sciences of India. pt. A, No. 1, vol. 21, *Physical Sciences.* The Institute, New Delhi, 1955. 81 pp.

Synoptic Analysis of Convection in a Rotating Cylinder. Geophysical Research Papers No. 34. J. Corn and D. Fultz. 72 pp. *Mean Molecular Weight of the Upper Atmosphere.* No. 36. Warren E. Thompson. U.S. Dept. of Commerce, Office of Technical Services, Washington 25, 1955. 23 pp.

Annual Report. An Outline of Research during the Fiscal Year 1953–1954. American Meat Inst. Foundation, Chicago 37, 1955. 58 pp.

Anuario Bago de Investigaciones Cientificas. vol. 1, No. 1. Instituto Bago de Investigaciones, Buenos Aires, 1954. 63 pp.

Vehicle Operation as Affected by Traffic Control and Highway Type. Highway Research Bull. 107. Natl. Acad. of Sciences–Natl. Research Council, Washington, 1955. 62 pp. $0.90.

Shopper Attitudes. Highway Research Bd. special rept. 11-A. Natl. Acad. of Sciences–Natl. Research Council, Washington, 1955. 71 pp. $2.25.

New Species of Tilapia (Pisces, Cichlidae) from Lake Jipe and the Pangani River, East Africa. Zoology, vol. 2, No. 12. Rosemary H. Lowe. 10s. *Review of the Notostraca.* Zoology, vol. 3, No. 1. Alan R. Longhurst. 12s 6d. *Revision of the Octopodinae in the Collections of the British Museum.* Zoology, vol. 3, No. 3. Grace E. Pickford. 5s.

Induced Abortion on Psychiatric Grounds. A follow-up study of 479 women. Acta Psychiatrica et Neurologica Scandinavica Supp. 99. Martin Ekblad. Munksgaard, Copenhagen, 1955. 237 pp.

Expert Committee on Midwifery Training. 1st rept. World Health Organization Tech. Rept. Ser. No. 93. 21 pp. $0.30. *Expert Committee on Biological Standardization.* 8th rept. World Health Organization Tech. Rept. Ser. No. 96. 19 pp. $0.30. The Organization, Geneva, 1955.

Bonampak, Chiapas, Mexico. Publ. 602. Karl Ruppert, J. Eric S. Thompson, and Tatiana Proskouriakoff. Carnegie Inst. of Washington, 1955. 71 pp. $3., paper; $3.75, cloth.

Field Evaluation of Houdry Catalytic Exhaust Converters. Rept. No. 8. Southwest Research Institute. Air Pollution Foundation, Los Angeles, 1955. 77 pp. $3.

Report of the Medical Research Council for the Year 1953–1954. Her Majesty's Stationery Office, London, 1955. 274 pp. 7s 6d (order from: British Information Services, New York 20).

Nutrition Practices: A guide for public health administrators. American Public Health Assoc., New York, 1955. 72 pp.

Metallurgical Works in Canada. pt. 1, Primary Iron and Steel. Dept. of Mines and Technical Surveys, Ottawa, Canada. 27 pp. $0.25.

Blight Resistant Chestnuts, Culture and Care. Hans Nienstaedt and Arthur H. Graves. Connecticut Agri. Expt. Station, New Haven. 18 pp.

A New Louisiana Copepod Related to Diaptomus (Aglaodiaptomus) Clavipes Schacht (Copepoda, Calanoida). Zoology, vol. 3, No. 2. Mildred Stratton Wilson. Tulane Univ., New Orleans, 1955. 47 pp. $0.30.

How to Draw in 3rd Dimension. David Gordon. William-Frederick, New York, 1955. $2.

Radiation Sterilization of Foods. Hearings before the Subcommittee on Research and Development of the Joint Committee on Atomic Energy, the Congress of the United States, Eighty-fourth Congress, first session. Govt. Print. Off., 1955. 59 pp. $0.20.

Information for Physicians on the Salk Poliomyelitis Vaccine. Hart E. Van Riper, Ed. Natl. Foundation for Infantile Paralysis, New York 5, 1955. 34 pp.

Scientific Meetings

Peacetime Uses of Atomic Energy

Although the topic of thermonuclear reactions was not on the program of the International Conference on the Peaceful Uses of Atomic Energy, Homi J. Bhabha, president of the conference and chairman of the Atomic Energy Commission of India, suggested in his opening speech on 8 Aug. that means for controlling the fusion reaction might be found within 20 years. Two days later, in a press conference, John Cockcroft, chairman of the United Kingdom delegation, stated that British scientists had been investigating this reaction, and George Thomson (United Kingdom) spoke of power from fusion within a generation. Then, on 11 Aug., Lewis L. Strauss, chairman of the United States delegation, stated in another press conference that U.S. scientists had been studying the possibility on a moderate scale for a considerable length of time, but that there had been no "breakthrough." He did not speculate about the time element. Bhabha returned to the subject in a press conference on 12 Aug. He suggested that thermonuclear reactions might be induced at temperatures considerably lower than those now required, that these temperatures could perhaps be attained with high-current accelerators, but that the problem of controlling the reaction would still remain to be solved. Bhabha concluded by stating that he thought fission reactors would not be made obsolete by the harnessing of the fusion reaction and that his estimate of 20 years still stood. On the last day, D. V. Skobeltzin, a Soviet delegate, announced that scientists in the U.S.S.R. had also been considering the problem "for a number of years."

The technical sessions of the conference were divided into three groups that met simultaneously each day to consider the following general topics: (i) physics and reactors; (ii) chemistry, metallurgy, and technology; and (iii) biology, medicine, and radioisotopes.

United Nations reports on the physics sessions called attention to the fact that scientists from the United Kingdom, the Soviet Union, and the United States were in close agreement on two measurements that previously had been classified in all three nations, namely, the number of neutrons emitted per fission, and nuclear cross sections. R. B. Leachman (U.S.) opened the way for this discussion when he summarized a paper, "Determination of fission quantities of importance to reactors," and reported the measurements of the numbers of neutrons per fission that had been made with large tanks of liquid scintillator. In the discussion that followed Leachman's paper, J. E. Sanders (United Kingdom) and M. S. Kozodaev (U.S.S.R.) reported measurements that were almost identical. The discussion of the number of fission neutrons was continued at a later session, when it was also revealed that scientists from the same three nations had found that thorium can be used in breeder reactors. H. Palevsky (U.S.) and W. R. Kanne (U.S.) presented new data on the "alpha" quantity—the ratio of the number of neutrons that are absorbed to those that cause fission. The nuclear cross sections about which precise measurements very nearly coincided applied to low-energy neutrons only. In a discussion that followed the papers, it was agreed that the work should be extended to high-energy neutrons, which will be used in some new types of reactors. H. Hurwitz (U.S.) summarized the present status of cross-section measurements and what still remains to be done. After the formal session, several participants met to prepare a set of world average values for several cross sections in the low-energy region. The values agreed on are reported on page 409 of this issue.

Theories of the fission process were described by A. Bohr (Denmark) and J. A. Wheeler (U.S.). Among the fundamental physical factors discussed were inelastic scattering of fast neutrons, measurement of the speed of neutrons, equipment and techniques used in measuring cross sections in both fissionable and nonfissionable materials, integral measurements, resonance integrals, zero energy and exponential experiments, and reactor kinetics. G. R. Keepin (U.S.) described measurements of delayed neutrons and J. A. Harvey (U.S.) gave the results of measurements of the absorption cross sections of several materials. Minute data on the absorption cross section of xenon-135, which is produced in fission of uranium and which absorbs neutrons so readily that it becomes a major problem in reactor operation, was presented by S. S. Bernstein (U.S.). The physics sessions were concluded with a group of papers on reactor theory.

Descriptions of the design, use, and operating experience of various types of research and power reactors occupied a large portion of the time in the reactor sessions. L. Kowarski (UNESCO) and E. Bretscher (United Kingdom) summarized the available information about the types of research reactors that have been built, and A. H. Snell (U.S.) surveyed the uses of research reactors in basic science. Comparisons were made among the graphite, heavy water, boiling water, and swimming pool types. Operating research reactors in Norway, France, Switzerland, the United Kingdom, the U.S.S.R., and the United States were described in detail. The U.S. reactors described were the materials-testing reactor, the Brookhaven reactor, and several boiling water reactors. In addition, J. R. Dietrich (U.S.) presented details of the construction and operation of a water-cooled and -modulated reactor that was made to "run away" in more than 200 safety experiments. These tests, he said, showed that such a reactor will automatically shut itself down before excessively high temperatures that would cause destruction of the reactor are attained. Motion picture records showed that the heat liberated by the run-away fission caused steam to form around the fuel plates; the resultant absence of neutron-moderating water immediately reduced the reactor power to a low point. After the test series had been completed, the reactor was sacrificed in an experiment that was violent enough to melt the fuel plates. The resultant explosion was "relatively mild," but it was "much more severe than any that might occur in operation." The reactor was destroyed. Most fuel-element fragments fell to the ground within a radius of 200 feet, and there was no appreciable radioactive fallout at distances greater than a few hundred feet.

Design details of power reactors capable of producing electricity at costs from 7 to 11 mills per kilowatt hour were presented in two sessions. C. Starr (U.S.) described a sodium-graphite reactor now under construction near Los Angeles that will be able to utilize either uranium or thorium as fuel. J. J. Went and H. de Bruyn (Netherlands) proposed the replacement of uranium rods in a homogeneous reactor by a suspension of powdered uranium oxide. C. Williams (U.S.) discussed the design for a large central power station that should produce 210 megawatts of electricity for an amount of heat that corresponds to 500 megawatts, which is an efficiency of 42 percent. The fuel would be a solution

of uranium in molten bismuth that would permit the production of steam at a temperature of approximately 900°F.

Both W. H. Zinn (U.S.) and J. W. Kendall (United Kingdom) described fast neutron reactors. Another session was devoted to design details of a fast neutron reactor under construction at Dounreay, Scotland, to the pressurized water reactor now being built at Shippingport, Pa., and to other reactors designed in France, Norway, the United Kingdom, the U.S.S.R., and the United States.

The chemistry, metallurgy, and technology sessions were opened by P. H. Kerr (U.N.), who summarized 94 papers on the natural occurrence of uranium and thorium that had been submitted from 23 countries. Kerr said that these papers provided assurance of the adequacy of these resources for many, many years to come. Detailed consideration of prospecting methods, techniques, and instruments followed.

A session on the construction of laboratories and facilities for handling radioactive materials was followed by several sessions on the chemistry of the fission process. Included were discussions of the solvent-extraction and ion-exchange processes for separating and purifying the radioactive by-products of reactor operation. Separation of chemical elements into their individual isotopes was also considered.

Two new words, *einsteinium* and *fermium*, were used for elements No. 99 and 100 by A. Ghiorso (U.S.) in a discussion of the chemistry of heavy elements. Both elements were first discovered in debris from the Oct. 1952 H-bomb explosion by G. Seaborg. Both einsteinium, symbol E, and fermium, symbol Fm, have since been formed in the University of California cyclotron and in nuclear reactors at Argonne National Laboratory and Los Alamos, N.M. All discovered elements through No. 101, mendelevium, have now been named.

The weakening and destruction of fuel, moderator, and construction materials in an operating reactor was considered in one session, and it was suggested that the use of alloys of uranium and molybdenum, uranium and magnesium, or others, might reduce this effect. Radiation-induced chemical changes in water were emphasized in the session on the effects of radiation on liquids, and the choice of materials for reactor construction was the chief topic in the session on the effects of radiation on solids.

Some other topics considered were the techniques for recovering uranium and thorium from their ores, and the production technology of special materials, which is made complicated by the fact that extreme purity is necessary. Graphite, heavy water, zirconium, and beryllium received particular attention. M. Benedict (U.S.) discussed both the technical and cost details of the production of heavy water by each of three methods, distillation, electrolysis of water, and chemical exchange. Methods for measuring purity received attention from J. Gaunt (United Kingdom), who described molecular spectra methods, and from K. V. Vladimirsky (U.S.S.R.), who described a weighing method that he said was suitable for use by relatively unskilled technicians.

Methods of fabricating reactor fuel elements for some of the reactors now in operation in the United States were described. Descriptions of techniques and actual designs were supplemented by detailed information on the basic metallurgy involved. Possibilities for improving heat transfer from inside the fuel element to the outside where it can be removed by the coolant were discussed by F. Boeschoten (Netherlands).

Liquid metal technology was the title of a session that was devoted to methods of handling liquid metals, liquid metal heat transfer, and corrosion in liquid metal systems. Sodium, sodium-potassium alloy, lead, and bismuth were discussed by British, Soviet, U.S., and Swedish scientists. This session was followed by two on the chemical processing of irradiated fuel elements. The chemistry, metallurgy, and technology sessions were concluded with discussions of the separation, storage, and disposal of fission products. Aspects of disposal in the ground and in the sea were considered.

United Nations summaries of conference proceedings stated that the production of radioisotopes for research in many fields is, for many nations, the most immediately available peacetime use of nuclear energy. Many papers described medical applications of isotopes, ways and means for handling these materials, and clinical and diagnostic work.

R. A. Silow (FAO) surveyed the uses of nuclear energy in biology and future prospects in this field against a background of a world population that increases by about 100,000 per day. He cited two chief ways by which supplies of food and other agricultural raw materials could be increased—the prevention of the vast wastage that now occurs, and the increase of production through investigation of both the fundamental processes of plant and animal physiology and soil and water problems. A. L. Kursanov (U.S.S.R.) summarized studies of root nutrition that had shown that carbon dioxide in soil is translocated to the leaf system.

A. Gustafsson (Sweden) discussed the use of isotopes to irradiate seeds to obtain mutants of crop plants that would be suitable for cultivation under the particular conditions under which it was desired to produce the crop. A. J. Riker (U.S.) reported studies of the extent of root grafting among forest trees and the speeds with which materials are translocated in individual trees, and, through root grafts, in families of trees. The materials studied included water, nutrients, and disease-inducing organisms. Experimental results obtained with the help of isotopes in other studies of plant physiology, animal physiology, and biochemistry were also presented.

The biological effects of radiation were considered at length. Discussions of modes of injury, mechanisms of injury, and bone-seeking isotopes were followed by papers on the human implications of radiation for human genetics. Two other sessions were devoted to safety standards and health aspects of the large-scale use of atomic energy. W. V. Mayneord (United Kingdom) reported that the International Commission for Radiological Protection had established the maximum permissible radiation for human beings at 0.3 roentgens per week. Other papers dealt with measurements of the uptake of radioactive materials by animals and plants in the neighborhood of reactors. V. L. Troitsky (U.S.S.R.) presented measurements of the effects of radiation on immunity, D. E. Clark (U.S.) considered the effects of the use of x-rays on the head and neck of children, and L. and W. L. Russell (U.S.) described the effects of x-irradiation on the embryos of mice. Studies of the effects of several types of radiation on microorganisms were presented by R. Latarget (France) and A. Hollaender (U.S.). In the discussions it was suggested that a comprehensive, long-range study of the effects of radiation should be instituted and that the World Health Organization should make efforts to coordinate the results of the investigations. It was also suggested that the proper disposal of atomic wastes will be a big problem in a world that generates large amounts of electric power with nuclear reactors and that a disposal code might have to be set up by international agreement.

The sessions that were entitled "Radioisotopes" in the program were devoted to techniques of production, methods of handling, methods of counting, and the uses of isotopes in industrial research, metallurgy, measurements of thickness, measurements of wear on parts, process and quality control, polymerization, and food sterilization.

In his review of conference highlights at the closing plenary session, H. J. Bhabha, conference president, stated, "The feasibility of generating electricity by atomic energy has been demonstrated beyond all doubt." Bhabha also mentioned the clarification of the economics

of nuclear power, the demonstration that the thorium-uranium-233 system is superior in several ways to the uranium-238-plutonium system, and the possibilities of breeding nuclear fuel in fast neutron reactors. He called for "concerted and massive research efforts" in the study of the genetic effects of radiation and suggested that it would be wise, wherever possible, not to permit people to be subjected to more than about one-tenth of the radiation dose considered safe at present. Bhabha closed with comment on the scientific and objective atmosphere of the conference and on the reestablishment of channels of international communication in science.

Meeting Notes

■ The Society of American Bacteriologists has announced that members desiring to suggest symposium topics for the Houston, Tex., meeting 29 Apr.–3 May, 1956, are requested to send their ideas to the chairman of the program committee, Dr. Orville Wyss, University of Texas, Austin 12, Tex. Because the 1956 meeting will be held almost 2 weeks earlier than usual, suggestions should be sent as soon as possible and *not later than 25 Sept.*

■ The American Society of Mechanical Engineers' diamond jubilee meeting will be held 13–18 Nov. in Chicago, Ill., at the Congress, Conrad Hilton, and Sheraton-Blackstone hotels. Special features commemorating ASME's 75th anniversary have been planned. More than 300 technical papers will be presented at 110 sessions covering a variety of subjects: aviation, applied mechanics, management, materials handling, oil and gas power, fuels, safety, hydraulics, metals engineering, heat transfer, process industries, production engineering, machine design, petroleum, nuclear engineering, railroad, power, textile, gas turbine power, wood industries, rubber, plastics, instruments and regulators.

The American Rocket Society, an affiliate of ASME that is celebrating its 25th anniversary this year, is holding its sessions within the ASME meeting.

At a special honors luncheon, the five major joint engineering awards will be conferred: the Hoover medal to Charles F. Kettering; the John Fritz medal to Philip Sporn; the Elmer A. Sperry award to William F. Gibbs; the Henry L. Gantt memorial medal to Walker L. Cisler; and the Daniel Guggenheim medal, recipient to be announced. Retiring president David W. R. Morgan will be toastmaster at the banquet.

Sidelighting the 75th anniversary celebration will be the Exposition of Power and Mechanical Engineering at the Chicago Coliseum, 14–18 Nov. Under the auspices of ASME, the exposition will feature displays that show the most recent developments in equipment power generation and distribution, automatic control, and mechanical power transmission and utilization. In addition there will be an exhibit devoted to atomic power.

■ The Oak Ridge Institute of Nuclear Studies has arranged a series of work conferences in cooperation with state academies of science. These meetings are designed to give inspiration and instruction in the area of science fairs as educational tools for the advancement of science. The conferees will be elementary and secondary teachers, instructional supervisors, educational administrators, and representatives from institutions of higher learning, industry, and the communication media.

The conference schedule follows: Florida Science Fair Work Conference, University of Florida, Gainesville, 25–26 Aug.; Georgia Work Conference on Science Fairs, University of Georgia, Athens, 30 Sept.–1 Oct.; Texas Science Fair Work Conference, University of Texas, Austin, 6–8 Oct.; West Virginia Science Fair Work Conference, Jackson's Mill, Weston, 30 Oct.–1 Nov.; North Carolina Fair Work Conference, North Carolina State Agricultural and Technical College, Greensboro, 18–19 Nov.

Society Elections

■ Southern Association of Science and Industry: pres., Frank J. Soday, Chemstrand, Decatur, Ala.; sec., George D. Palmer, University of Alabama; treas., Clayton D. McLendon, C. and S. National Bank, Atlanta, Ga.; research director, executive staff, and representative to the AAAS Council, H. McKinley Conway, Jr., SASI, North Atlanta, Ga. The vice presidents at large are Edwin Cox, Virginia-Carolina Chemical Corp., Richmond, and Les M. Taylor, Mississippi Power and Light Co., Jackson.

■ Society for Nondestructive Testing: pres., William C. Hitt, Douglas Aircraft Co., Inc., Santa Monica, Calif.; v. pres., Hamilton Migel, Magnaflux Corp., Chicago; sec., Philip D. Johnson, 1109 Hinman Ave., Evanston, Ill.; treas., Richard F. Holste, General Electric Co., Milwaukee, Wis.

■ American Institute of Industrial Engineers, Inc.: pres., E. L. Slagle, Columbia-Geneva Steel Division, United States Steel Corp., Pittsburg, Calif.; treas., Frank T. Geyer, 187 Garden Rd., Columbus 14, Ohio; exec. sec., J. L. Southern, Commercial Motor Freight, Inc., Columbus, Ohio; asst. exec. sec., Stephen D. Veirs, F. & R. Lazarus & Co., Columbus, Ohio. The vice presidents are William N. Egan, 3710 Bangor St., SE, Washington 20, D.C. (northeast region); Dale Jones, Georgia Institute of Technology, Atlanta (southeast region); John M. Farnbacher, G. H. R. Foundry Division, Dayton Malleable Iron Co., Dayton, Ohio (central region); Frederick D. Macy, 3710 Odin Court, Houston 21, Tex. (southwest region); and W. Grant Ireson, Stanford University (west region).

■ Society of Exploration Geophysicists: pres., R. C. Dunlap, Jr., Geophysical Service, Inc., Dallas, Tex.; v. pres., Dave P. Carlton, Humble Oil and Refining Co., Houston, Tex.; sec-treas., George A. Grimm, Tide Water Associated Oil Co., Midland, Tex.

■ Institute of Mathematical Statistics: pres., Henry Scheffé, University of California, Berkeley; pres.-elect, David Blackwell, University of California, Berkeley; sec., George E. Nicholson, Jr., University of North Carolina; treas., Albert H. Bowker, Stanford University.

■ American Industrial Hygiene Association: pres., N. V. Hendricks, Esso Research and Engineering Co., Linden, N.J.; pres-elect, Lester V. Cralley, Aluminum Co. of America, Pittsburgh, Pa.; past pres., Herbert T. Walworth, Lumbermens Mutual Casualty Co., Chicago, Ill.; sec., Norton Nelson, New York University Medical Center, New York; treas., Joseph F. Treon, Kettering Laboratory, Cincinnati, Ohio; exec. sec., George D. Clayton, 14125 Prevost, Detroit 27, Mich. Representative to the AAAS council is Lester M. Petrie, Georgia Health Department, Atlanta.

Forthcoming Events

October

3–5. National Electronics Conf., 11th annual, Chicago, Ill. (Executive Secretary, NEC, 84 E. Randolph St., Chicago 1.)

3–6. Soc. of Exploration Geophysicists, 25th annual, Denver, Colo. (C. Campbell, SEG, 624 S. Cheyenne, Tulsa, Okla.)

3–7. American Inst. of Electrical Engineers, fall general, Chicago, Ill. (N. S. Hibshem, 33 W. 39 St., New York 18.)

4–6. American Meteorological Soc., Stillwater, Okla. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

4–6. International Assoc. of Milk and Food Sanitarians, Augusta, Ga. (H. L. Thomasson, IAMFS, Box 437, Shelbyville, Ind.)

6–8. Academy of Psychosomatic Medicine, 2nd annual, New York, N.Y. (E. A. Brown, 75 Bay State Rd., Boston, Mass.)

6–8. Optical Soc. of America, Pittsburgh, Pa. (A. C. Hardy, Room 8-203, Massachusetts Inst. of Technology, Cambridge 39.)

6–8. Soc. of Industrial Designers, 11th annual, Washington, D.C. (S. G. Swing, SID, 48 E. 49th St., New York 17.)

6–8. Texas Science Fair Work Conf., Austin. (D. E. Large, Science Fair Program, P.O. Box 117, Oak Ridge, Tenn.)

9–13. Electrochemical Soc., Pittsburgh, Pa. (H. B. Linford, 216 W. 102 St., New York 25.)

9–14. American Acad. of Ophthalmology and Otolaryngology, Chicago, Ill. (W. L. Benedict, 100 First Avenue Bldg., Rochester, Minn.)

10–12. American Acad. for Cerebral Palsy, annual, Memphis, Tenn. (R. A. Knight, AACP, 869 Madison Ave., Memphis 3.)

10–12. American Oil Chemists' Soc., Philadelphia, Pa. (Mrs. L. R. Hawkins, AOCS, 35 East Wacker Drive, Chicago 1, Ill.)

10–12. National Prestressed Concrete Short Course, 1st, St. Petersburg, Fla. (A. M. Ozell, Civil Engineering Dept., Univ. of Florida, Gainesville.)

10–13. National Clay Conf., 4th, University Park, Pa. (T. F. Bates, College of Mineral Industries, Pennsylvania State Univ., University Park.)

10–21. New York Acad. of Medicine Graduate Fortnight on Problems of Aging, New York (R. L. Craig, 2 East 103 St., New York 29.)

11. Illinois State Geological Survey, 50th anniversary, Urbana, Ill. (J. C. Frye, 121 Natural Resources Bldg., Univ. of Illinois, Urbana.)

12–13. Symposium on Phospholipids, London, Ontario. (R. J. Rossiter, Dept. of Biochemistry, Univ. of Western Ontario, London, Ont.)

13. Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, 4800 S. Richmond, Chicago 32.)

13–15. Indiana Acad. of Science, Notre Dame. (W. A. Daily, Eli Lilly and Co., 740 S. Alabama St., Indianapolis 6, Ind.)

13–15. Canadian Physiological Soc., annual, London, Ontario. (J. M. R. Beveridge, Dept. of Biochemistry, Queen's Univ., Kingston, Ont.)

14–15. National Soc. of Professional Engineers, Memphis, Tenn. (K. E. Trombley, NSPE, 1121 15 St., NW, Washington 5.)

16. American College of Dentists, San Francisco, Calif. (O. W. Brandhorst, 4221 Lindell Blvd., St. Louis, Mo.)

16–19. Soc. of American Foresters, Portland, Ore. (H. Clepper, 425 Mills Bldg., Washington 6.)

17–19. Detroit Institute of Cancer Research, 8th annual, Detroit, Mich. (Wm. L. Simpson, 4811 John R.St., Detroit 1.)

17–20. American Dental Assoc., annual, San Francisco, Calif. (H. Hillenbrand, 222 E. Superior St., Chicago 11.)

17–21. American Soc. of Civil Engineers, New York, N.Y. (W. N. Carey, ASCE, 33 W. 39 St., New York 18.)

17–21. National Metal Exposition and Cong., Philadelphia, Pa. (C. L. Wells, 7301 Euclid Ave., Cleveland 3, Ohio.)

18. American Soc. of Safety Engineers, annual, Chicago, Ill. (J. B. Johnson, 425 N. Michigan Ave., Chicago 11.)

18. Oak Ridge Inst. of Nuclear Studies, council meeting, Oak Ridge, Tenn. (W. G. Pollard, P. O. Box 117, Oak Ridge.)

18–19. National Acad. of Economics and Political Science, Washington, D.C. (D. P. Ray, Hall of Government, George Washington Univ., Washington 6.)

18–20. Entomological Soc. of Canada and the Acadian Entomological Soc., annual joint meeting, Fredericton, New Brunswick. (R. H. Wigmore, Science Service Bldg., Ottawa, Canada.)

18–21. American Dietetic Assoc., annual, St. Louis, Mo. (R. M. Yakel, ADA, 620 N. Michigan Ave., Chicago 11, Ill.)

19–21. Symposium on Applications of Radioactivity in Food and Food Processing Industries, Boston, Mass. (W. A. Stenzel, Tracerlab Inc., 130 High St., Boston 10.)

19–21. International Conf. on the Use of Antibiotics in Agriculture, Washington, D.C. (H. I. Cole, National Research Council, Div. of Biology and Agriculture, 2101 Constitution Ave., Washington 25, D.C.)

20–21. National Noise Abatement Symposium, 6th annual, Chicago, Ill. (R. W. Benson, Armour Research Foundation, Illinois Inst. of Technology, Chicago.)

(See 19 August issue for comprehensive list.)

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4. Programs of the 17 AAAS sections (symposia and contributed papers).
5. Programs of the more than 60 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Editorial Problems, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Municipal Auditorium—center of the Meeting—and hotels and campuses.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1955 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1955.
2. Complete roll of AAAS presidents and their fields.
3. The more than 265 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
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9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

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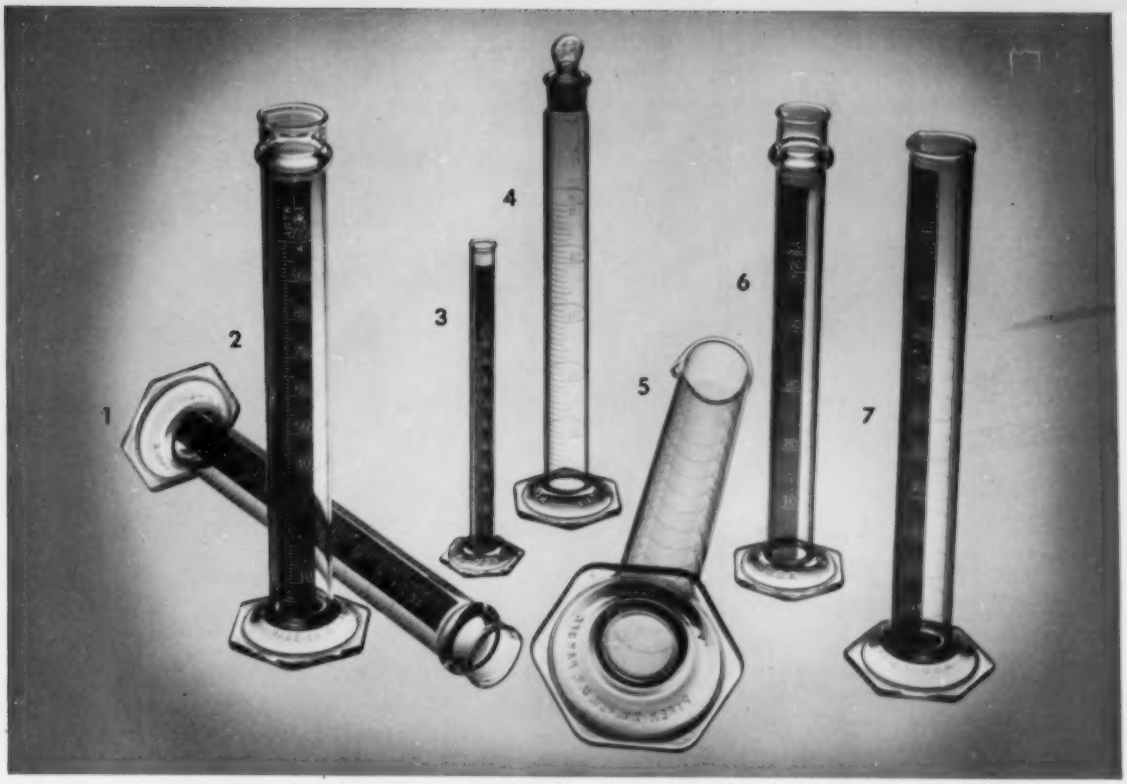

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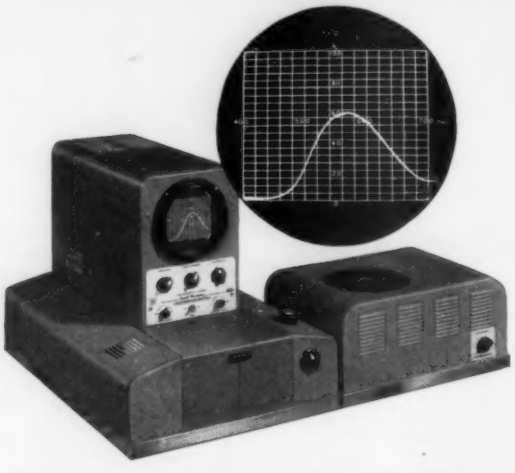
Rapid Scanning
SPECTROPHOTOMETER



Tooled to save costs. AO Rapid Scanning Spectrophotometer now priced at $2396.00. Reflection Attachment; $297.00.

FAST, ACCURATE, EASY TO OPERATE—a laboratory workhorse that adds the element of instantaneous results to routine analysis, investigative and general spectrophotometric work.

RAPID SCANNING FEATURE allows rapid analyses of transparent or opaque materials; gaseous, liquid or solid. *Allows* monitoring of flowing processes. *Allows* following of color changes and transient phenomena. How? The AO SPECTROPHOTOMETER traces 60 separate curves per second on the face of a cathode ray recording a "moving picture" of color changes taking place in a specimen over the entire visible spectrum (all wave lengths from 400 to 700 millimicrons).

Sample chamber accommodates transparent samples up to 100mm thick. An accessory reflection attachment enables the instrument to produce data from opaque surfaces as small as one inch square.

Permanent records can be made with any of the standard 5" oscilloscope cameras.

NEW PULSING ATTACHMENT

This new electronic attachment permits a choice of one, six or sixty scans per second. Some slow chemical reactions cause the normal 60 cycle scan to produce partially overlapping or blurred spectrum curves. For studying such reactions, this attachment produces well separated, meaningful curves.

NEW REMOTE INDICATING SPECTROPHOTOMETER

Allows placement of indicator unit up to 50 feet away from the sample chamber. For use on control problems of flowing materials such as dyes or petroleum products. If your process control check is located some distance away from the point where actual changes are made, this new remote feature can be a valuable tool.

American Optical

INSTRUMENT DIVISION • BUFFALO 15, N.Y

Dept. U1. Please send me full information and new low prices on:

- ☐ AO Rapid Scanning Spectrophotometer
- ☐ NEW AO Remote Indicating Spectrophotometer
- ☐ NEW AO Spectrophotometer Pulsing Accessory

NAME .....

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CITY ..... STATE .....